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POLLEN ANALYSIS OF HONEY FROM SELECTED SOUTH WEST ECOLOGICAL ZONES OF NIGERIA

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ABSTRACT
Geographical origins and floral sources of honeys of different localities are determined by pollen analysis. The information derived may be used to develop analytic standards for pollen contents in form of quality control and assurance steps for honeys meant for exports and domestic uses but has never been employed in south west Nigeria. We analyzed pollen contents of some honey samples sourced from selected commercial apiaries within south west, Nigeria. Eighteen botanical families with 30 different pollen types were identified to species level. South west Nigeria is dominated by Elaeis guineensis (Arecaceae). While other botanical taxa include Lannea triphylla (Anacardiaceae), Tridax procumbens (Asteraceae), Pouteria sericea (Sapotaceae) and Talinum triangulare (Talinaceae) representing secondary pollen types. The minor pollen taxa include Avicennia officinalis (Acanthaceae), Mangifera indica (Anacardiaceae), Vernonia cinereal (Asteraceae), Jacaranda mimosifolia (Bignoniaceae), Carica papaya (Caricaceae), Cassia fistula (Fabaceae), Erythrina mildbraedii (Fabaceae), Irvingia gabonensis (Irvingiaceae), Ocimum basilicum, Ocimum gratissimum (Lamiaceae), Triumfetta cordifolia, Sida acuta, Cola nitida (Malvaceae), Guaduella oblonga (Poaceae) and Protea elliottii (Proteaceae). Bee-favoured botanical families identified include Anacardiaceae, Asteraceae, Arecaceae, Sapotaceae and Talinaceae. From the study, Elaeis guineensis was widely dispersed and widely foraged by honeybees, Apis mellifera adansonii, within south west Nigeria. The honey samples are multifloral. The study provides pollen profiles of south western Nigerian honeys with prospects in Apitherapy and setting of quality control standards. It also provides information on the major plants foraged by honeybees within the region for seasonal bee management to enhance productivity.
KEY WORDS: *honeybees, palynology, pollens, south western Nigerian honey, Elaeis guineensis*

INTRODUCTION

Honeybees produce honey from nectars and pollens gathered from different types of vegetations needed for their survival. Excess pollens gathered are processed and stored in honeycombs during honey flow period which are used when nectar and pollens are scarce. Honey stored in honeycombs in beehives are harvested for various uses. Various types of plants are visited by honeybees to gather pollens and nectars

resulting to compositional differences in honey originating from different ecological zones. This influenced the quality of honey (Flodhazi, 2004; Ianovici *et al*, 2010). Honeybees pollinate wide variety of receptive flowers of horticultural importance when foraging. Hence, they are directly involved in biodiversity and ecological conservation of variety of plant species. Economic importance of products of *A. mellifera* include uses of honey in treating burns and wild wounds of victims which is embraced in orthodox medicine due to herbal active components of certain medicinal botanicals likely foraged by honeybees. Also, trado-medical practitioners in Nigeria use natural honey as major component with little or no additive in treatment of some ailments. In Turkey, "mad honey" was used to treat diabetes while the Greeks used honey to treat measles, gastric ulcer and constipation (Molan, 1999, 2001; Oztasan *et al*., 2005). Sowunmi (1976; 1995), because of broad economic uses of honey, realized the need for specific melissopalynological study of honey in some selected regions across Nigeria. He determined and provides diagnosis of botanical origin of honey from selected ecological zones. Hence, providing good botanical fingerprint of the environment from which the honey originated. Song *et al*., (2012) reported on qualitative and quantitative melissopalynological analyses of natural honeys from the Central Region of Shanxi, North China. About 19 Chinese honeys were classified by botanical origin to determine their floral sources. Sixty-one pollen types with 37 families were identified. Fourteen samples were classified as unifloral while the remaining samples were multifloral. Bee-favoured families in Central Region of Shanxi, North China include Fabaceae (found in 19 samples), Asteraceae (17), Rhamnaceae (15), Moraceae (13), Brassicaceae (12), Rosaceae (12), Caprifoliaceae (10) and Lamiaceae (10) (Song *et al*., 2012). The findings of Song *et al*., (2012) showed the dominance of unifloral honeys without toxic pollen grains and low value of the HDE/P ratio (i.e., honey dew elements / pollen grains from nectariferous plants). This indicated that the honey samples are of good quality and suitable for human consumption (Song *et al*., 2012). Omer *et al*., (2016) also studied the pollen analysis of honey samples from Hizan district of Bitlis province, eastern region of Turkey. They identified and reported nine botanical families which include Fabaceae, Asteraceae, Boraginaceae, Brassicaceae, Chenopodiaceae, Ericaceae, Lamiaceae Rosaceae and Apiaceae. Fabaceae and Asteraceae were reported to be the dominant botanical families. Their analyses revealed that the honey samples were multifloral. The study by Omer *et al*., (2016) provides new insights into the pollen composition of honey from plant floral of Hizan district in Bitlis province. They emphasized that the information could be used to develop analytical standards for pollen content of Hizan honey in Hizan district in Bitlis province, eastern region of Turkey. Mirjana *et al*., (2011) studied the pollen percentage, pollen spectrum and different botanical origins of 8 honeys from Varaždin County, Croatia. Twenty different types of pollen grains were identified. The dominant group of pollen taxa include *Castanea sativa* Mill. The pollen

analysis revealed 6 unifloral and 2 multifloral honeys (Mirjana *et al*., 2011). Between 2003 and 2005 in the Sandomeirska Upland area of Poland, 73 samples of multifloral honeys were analyzed and reported by Stawiarz and Wroblewska (2010). About 103 of pollen taxa (78 nectariferous and 28 non- nectariferous taxa) belonging to 52 botanical families were identified. The dominant botanical family was Brassicaceae with high pollen frequency of 52 – 100% among the nectariferous plants (Stawiarz & Wroblewska, 2010). Members of the botanical family, Brassicaceae, identified include *Brassica napus*, *Prunus* spp., *Trifolium repens*, *Anthricus* spp., *Aesculus* spp., *Salix* spp., *Taraxacum* spp., and *Phacelia* spp. Poaceae was reported to have high pollen frequency (89.0%) among the non- nectariferous plants. The Poaceae family include *Quercus* spp., *Rumex* spp., *Plantago* spp. and *Filipendula* spp. (Stawiarz & Wroblewska, 2010).

Jones and Bryant (2014) examined the pollens of 37 honey samples from East Texas. A total of 431 pollen taxa was identified and categorized into 61 botanical families, 104 genera and 85 species. Most samples were reported to be multifloral, indicating a high diversity in botanical origin (Jones & Bryant, 2014). Sowunmi (1976) identified about 70 pollen taxa from honey samples sourced from eight localities in southern Nigeria excluding honey samples from Iwo (Osun), Ago-Iwoye (Ogun), Iseyin (Oyo), Idofian (Kwara) and Idanre (Ondo). The pollen taxa clearly reflect the botanical and geographical origins of the honey samples studied (Sowunmi,1976). Also, Ige and Modupe (2010) analyzed 20 honey samples collected from the North Central Zone of Nigeria of which 36 pollen types were identified. It was reported that thirteen honey samples were unifloral while seven were multifloral. The dominant pollen types were identified to include *Parinari kerstigii*, *Lannea* sp., *Syzigium* sp., *E. guineensis*, *Entanda abyssinica* and *Butyrospermum paradoxum.* The pollen spectra of the samples were indicators of various plant species visited by honeybees in North Central Zone of Nigeria which reflected the vegetation types of North Central Nigeria. Ige and Modupe (2010) concluded that the numerous pollen types and their diversity showed that honeybees probably travel considerable distance to gather nectar and pollen for honey production. In the study of Oyeyemi and Kayode (2012), some important botanical plants such as *Spondias mombin*, *Alchornea cordifolia*, *Lannea* spp., *Alchornea* spp., *E. guineensis*, *Pavetta* spp., *Oldenlandia corymbosa*, *Triplochiton scleroxylon*, *Mimusops warneckii*, *Blighia sapida*, *Piptadeniastrum africanum*, *Entada gigas*, *Tithonia diversifolia*, and members of the families of Asteraceae, Rubiaceae, Combretaceae and Melastomataceae respectively were identified to be characteristics of vegetation typical of Ekiti State which is part of south west, Nigeria. Iwo, Ago-Iwoye, Iseyin, Idofian and Idanre are major towns in south west, Nigeria, where agricultural and agro-allied activities are prominent. These major towns were excluded in past palynological studies of honey from south west, Nigeria. Hence, using palynological analysis, the study determined the botanical

characterization of honey samples from randomly selected colonies of *A. mellifera adansonii* in apiaries from selected towns within south west, Nigeria. It was aimed to provide pollen profiles of honey from the selected ecological zones to the benefit of regional beekeepers with respect to botanical composition of their honey and quality management. This will probably enhance the economic empowerment programme embarked on by Federal Republic of Nigeria on apiculture for her citizenry.

MATERIALS AND METHODS

Samples collection. Five honey samples were specifically sourced from each ecological zone per state which include Iwo (Osun state), Ago-Iwoye (Ogun state), Iseyin (Oyo state), Idofian (Kwara state) and Idanre (Ondo state) respectively excluding Ekiti state. The honey samples were stored in a refrigerator at 4ºC in different airtight 250ml universal bottles with screw caps pending the pollen analyses.

Pollen analysis. Palynological analysis of honey samples was done using standard acetolysis method by Erdtman (1960) adopting modifications recommended by International Commission for Bee Botany (Louvearux *et al*., 1978; Von der Ohe *et al*., 2004; Ianovici *et al*, 2008). For microscopic study, three slides were prepared for each sample and examined for pollen content under x100 objective lens of Light optical microscope (Olympus CH30 Microscope) with oil immersion. Photomicrographs were taken with the aid of attached camera. Pollen identification was carried out with the aid of photomicrograph albums and reference slide collections of modern pollens, prepared from the collection of local flora (Repository of spore-pollen slides of modern taxa, Palynology Unit, Department of Archaeology and Anthropology, University of Ibadan, Oyo State, Nigeria). Relevant literatures of Moore and Webb (1978) and Sowunmi (1995), Willard, *et al*., (2004), Andrada and Telleri´a (2005), Goji and Ayodele (2005), Bibi *et al*., (2008), Celenk *et al*., (2008), Ibrahim *et al*., (2012), Shubharani *et al*., (2013), Gosling *et al*., (2013), Akinnubi *et al*., (2014), Ponnuchamy *et al*., (2014), El-Amier (2015), Mourellel and Prieto (2016) and Naskar, (2016) were referenced. Majority of the pollen types were identified up to species level.

Quantitative pollen analysis was done based on the recommendations of International Commission for Bee Botany (Louveaux *et al*., 1978). Pollen frequency classes were determined as dominant pollen types (represented by > 45% of the pollen grains counted), secondary pollen types (16-44%), important minor pollen types (3-15%), and minor pollen types (<3%). Any honey sample with one dominant pollen type was regarded as unifloral or multifloral if otherwise. Percentage frequency of each pollen type was determined using the formula: % Frequency = (Number of pollen type x100) ÷ Total number of pollens.

RESULTS AND DISCUSSIONS

Thirty pollen taxa belonging to eighteen (18) botanical families were identified to species level (Fig. 1 and 2). Ten botanical families with thirteen pollen types were identified from Idofian and nine botanical families with nine pollen types from Ago-Iwoye. Idanre had ten botanical families with nine pollen types. Eight botanical families with ten pollen types were identified from Iwo while Iseyin had twelve botanical families with thirteen species.

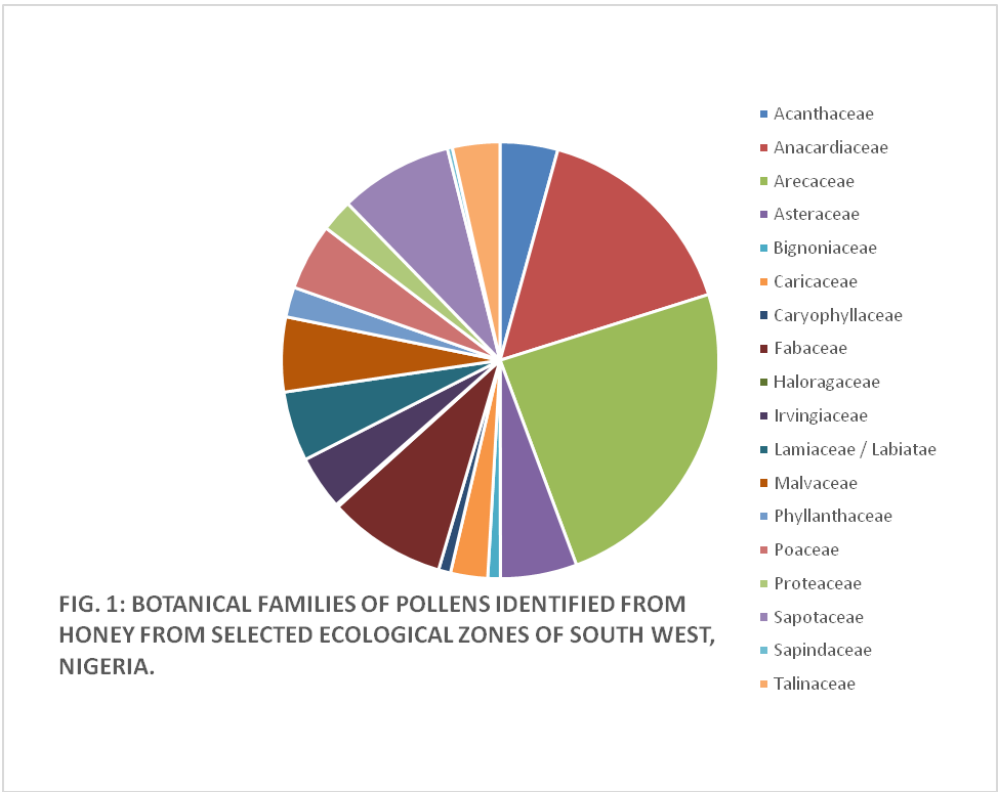


FIG. 1: BOTANICAL FAMILIES OF POLLENS IDENTIFIED FROM HONEY FROM SELECTED ECOLOGICAL ZONES OF SOUTH WEST, NIGERIA.

Elaeis guineensis (Arecaceae) was the most common within the studied locations of south western Nigeria and most predominant (49.8% in Iwo - Osun state). *Mangifera indica* (Anacardiaceae) were present in four selected ecological zones except Ago-Iwoye - Ogun state. This does not mean that *M. indica* does not exist in Ogun state but probably not foraged by honeybees as at the time of the study or not within the reach of foraging bees. *Guaduella oblonga* (Poaceae) exist in the studied locations except Idofian - Kwara State.

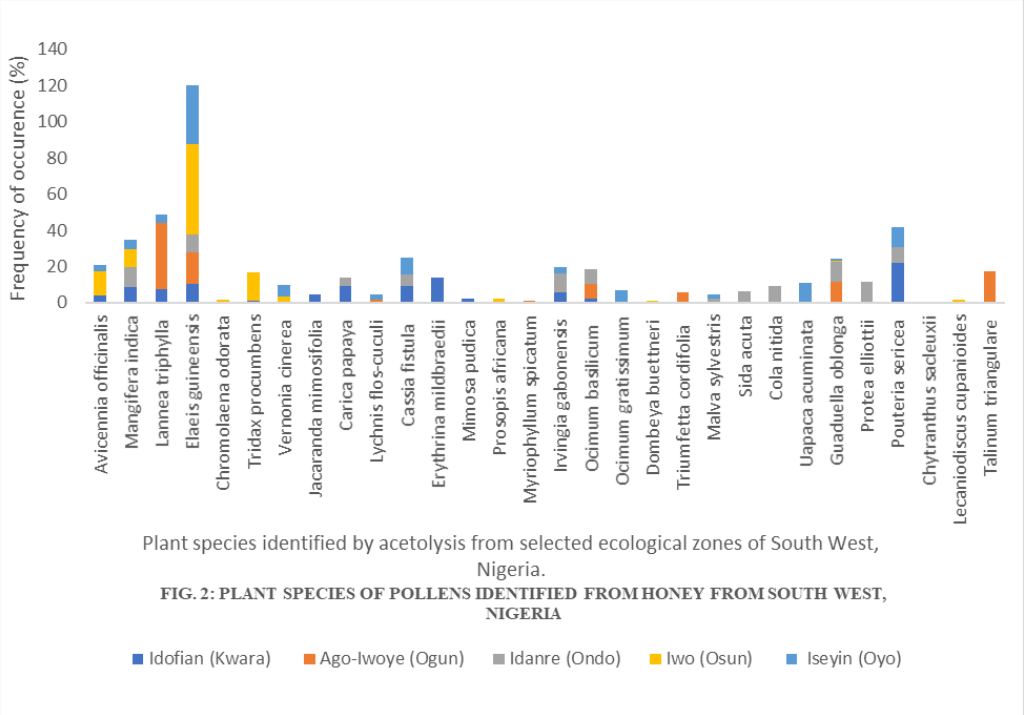
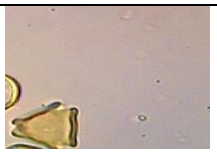
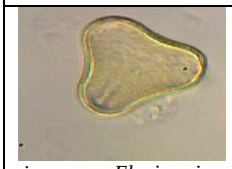
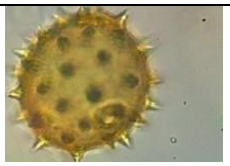
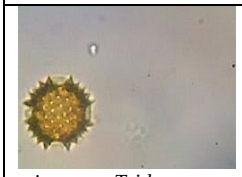
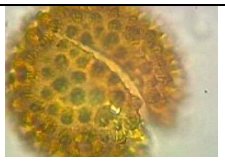
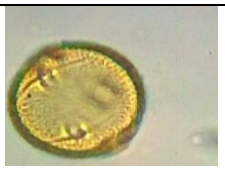
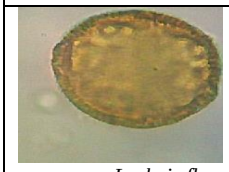
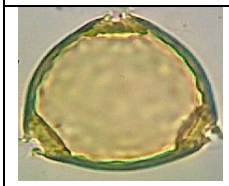


FIG. 2: PLANT SPECIES OF POLLENS IDENTIFIED FROM HONEY FROM SOUTH WEST, NIGERIA

Except for *E. guineensis* which was the only predominant species and most common, *L. triphylla*, *T. procumbens*, *P. sericea* and *T. triangulare* represent secondary pollen types in the samples. While the important minor pollen taxa include *A. officinalis*, *M. indica*, *V. cinerea*, *J. mimosifolia*, *C. papaya*, *C. fistula*, *E. mildbraedii*, *I. gabonensis*, *O. basilicum*, *O. gratissimum*, *T. cordifolia*, *S. acuta*, *C. nitida*, *G. oblonga* and *P. elliottii* (Fig. 2). Bee-favoured botanical families in the studied ecological zones were Anacardiaceae, Asteraceae, Arecaceae, Sapotaceae and Talinaceae. Table 1 depicts microphotographs of identified pollens from honey sourced from selected ecological zones of south west, Nigeria.

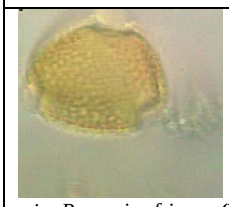
TABLE 1: Microphotographs of identified pollens from honey sourced from selected ecological zones of South West, Nigeria.

 i. *Avicennia officinalis* **(Acanthaceae)**	 xv. *Myriophyllum spicatum* **(Haloragaceae)**
 ii. *Mangifera indica* **(Anacardiaceae)**	 xvi. *Irvingia gabonensis* **(Irvingiaceae)**
 iii. *Lannea triphylla* **(Anacardiaceae)**	 xvii. *Ocimum basilicum* **(Lamiaceae)**
 iv. *Elaeis guineensis* **(Arecaceae)**	 xviii. *Ocimum* ***gratissimum*** **(Lamiaceae)**
 v. *Chromolaena odorata* **(Asteraceae)**	 xix. *Dombeya buettneri* **(Malvaceae)**
 vi. *Tridax procumbens* **(Asteraceae)**	 xx. *Sida acuta* **(Malvaceae)**

 vii. *Vernonia cinerea* **(Asteraceae)**	 xxi. *Cola nitida* **(Malvaceae)**
 viii. *Jacaranda mimosifolia* **(Bignoniaceae)**	 xxii. *Uapaca acuminata* **(Phyllanthaceae)**
 ix. *Carica papaya* **(Caricaceae)**	 xxiii. *Guaduella oblonga* **(Poaceae)**
 x. *Lychnis flos-cuculi* **(Caryophyllaceae)**	 xxiv. *Protea elliottii* **(Proteaceae)**
 xi. *Cassia fistula* **(Fabaceae)**	 xxv. *Pouteria sericea* **(Sapotaceae)**
 xii. *Erythrina mildbraedii* **(Fabaceae)**	 xxvi. *Chytranthus sacleuxii* **(Sapindaceae)**

xiii. *Mimosa pudica* **(Fabaceae)**

xxvii. *Lecaniodiscus cupanioides* **(Sapindaceae)**



xiv. *Prosopis africana* **(Fabaceae)**

*The microphotographs are arranged vertically in numerical order.

Anacardiaceae, Asteraceae, Arecaceae, Poaceae, Sapotaceae and Talinaceae were botanical families mostly visited within the selected ecological zones of south west, Nigeria which differ from Caesalpiniaceae, Malvaceae, Rubiaceae, Papilionaceae, Sapindaceae and Euphobiaceae except for Arecaceae and Poaceae which are common as identified by Oyeyemi and Kayode (2012, 2013) in Ekiti state. Oyeyemi and Kayode (2013) identified and listed *Adenia cissampeloides*, *Euphorbia hirta* and *E. guineensis* as dominant pollen types in Ekiti state. *Cola nitida, C. sacleuxii, C. papaya, E. mildbraedii, J. mimosifolia, L. cupanioides, L. flos-cuculi, M. spicatum, V. cinerea, D. buetnerri, C. odorata, M. pudica, P. Africana, P. elliottii, T. triangulare, T. cordifolia, T. procumbens, U. acumunata, S. acuta* and *O. gratissimum* were identified in this study but less frequently foraged by *Apis mellifera adansonii*. Omoloye and Akintola (2006) listed *Chromolaena odorata* (Asteraceae), *E. guineensis* (Arecaceae), *M. indica* (Anacardiaceae), *T. triangulare* (Talinaceae) and *T. procumbens* (Asteraceae) visited by honeybees, *Apis mellifera adansonii* for nectar and pollens in south west, Nigeria. These were similar plant taxa identified by this study, although from different ecological zones. This indicated that some plant taxa are common in south west, Nigeria. Although, Adenipekun (2012) reported that *E. guineensis, B. grandifolia, T. procumbens, C. odorata, Combretum apiculatum* and *Nymphaea lotus* were most common in south west, Nigeria. Ige and Modupe (2010) identified *E. guineensis* as one of the most dominant pollen types in honey samples from North central (Abuja and Kaduna) zone. Honey pollen types in south east, Nigeria, include *Lannea microcarpa, Senna alata, Daniellia oliveri, Parkia biglobosa, Hymenocardia acida, Lophira lanceolata, Syzygium guineense, Parinari* spp., *E. guineensis, Alchornea cordifolia* and members of botanical families of Combretaceae and Melastomataceae (Njokuocha and Ekweozor, 2007). *Parinari kerstingii, Lannea*

spp., *Syzygium* spp., *Entada abyssinica*, *Butyrospermum paradoxum*, and the botanical family of Poaceae were also common in North Central, Nigeria (Ige and Modupe, 2010). This study and other published literatures confirmed that *E. guineensis* (Arecaceae) is cosmopolitan in Nigeria.

The identified pollen types of the acetalized samples displayed varied sources of vegetation of plants species visited by honeybees for nectar collection in production of honey. By implication, all the analyzed samples are multifloral. This suggests that the samples are from different plants of varied botanical families. Thus, providing insights into possible pollen composition of honey from the selected ecological zones within south west, Nigeria. Identification of bee foraged plants helps to improve the efficiency of beekeeping industry and commercial honey production by providing pollen profiles of honey for quality control standardization. South West of Nigeria is one of the leading geopolitical zones in Nigeria with potential botanical vegetations for development of beekeeping industry adopted as youth empowerment programme in Nigeria.

CONCLUSIONS

Despite identification of pollens present in honey to have information about the botanical and geographical origin of honey for quality evaluation and medicinal therapies. This study also provides additional information on the major botanical florals foraged by honeybees in the studied region. This will help beekeepers in South west, Nigeria to formulate seasonal bee management schedule particularly for migratory bee colonies to different floral sources seasonally.

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REFERENCES

- Adeonipekun, P.A. 2012. Palynology of honeycomb and honey sample from an apiary in Lagos, South West, Nigeria. *Asian Journal of Plant Science and Research*, 2 (3):274 – 283.
- Akinnubi, F.M., Akinloye, A.J., Oladipo, O.T. 2014. Pollen Grain Morphology of Some Selected Species of Asteraceae in South Western Nigeria. *Research in Plant Biology*, 4(6):17 – 23.
- Andrada, A.C., Telleri´A, M.C. 2005. Pollen collected by honey bees (*Apis mellifera* L.) from south of Camden district (Argentina): botanical origin and protein content. *Grana*, 44:1 – 8.
- Bibi, S., Husain, S.Z., Malik, R.N. 2008. Pollen analysis and heavy metals detection in honey samples from seven selected countries. *Pakistan Journal of Botany*, 40 (2):507 - 516.
- Celenk, S., Tarimcilar, G., Bicakci, A., Kaynak, G., Malyer, H. 2008. A palynological study of the genus: Mentha L. (Lamiaceae). *Botanical Journal of the Linnean Society*, 157(1):141 – 154.
- El-Amier Y.A. 2015. Morphological studies of the pollen grains for some hydrophytes in coastal Mediterranean lakes, Egypt. *Egyptian Journal of Basic and Applied Sciences*, 2(2):132 – 138.
- Erdtman, G. 1960. The acetolysis method: a revised description. *Svensk Botanisk Tidskrift*, 54:561 – 564.

- Flodhazi, G. 2004. Analysis and quantification of sugars in honey of different botanical origin using high performance liquid chromatography. *Acta Alimentatia*, 23(3):299 - 311.
- Goji, T.C., Ayodele, A.E. 2005. Foliar epidermal and Pollen Characters in the genus *Cola* Schott. & Endl. in Nigeria. *Acta SATECH*, 2(2):57 – 63.
- Gosling, W.D., Miller, C.S., Livingstone, D.A. 2013. Atlas of the tropical West Africa pollen flora. *Review of Palaeobotany and Palynology*, 199:1 – 135.
- Ianovici N., Ionuti A., Zbîrcea S., Craşovan G. 2008. Preliminary contribution to the characterization of commercial unifloral honey samples by melissopalynology analysis, *Annals of West University of Timişoara, ser. Biology*, 11:85-94
- Ianovici N.,Birzescu V., Simeanu C. G., Todosi A.L., Ciuciu A.E., Ambruş L. 2010. Contributions to the morphology of pollen from some varieties of *Malus domestica, Pyrus communis, Prunus domestica, Prunus persica* and *Prunus armeniaca*, *Annals of West University of Timişoara, ser. Biology*, 13: 115-128
- Ibrahim, I.F., Balasundram, S.K., Abdullah, N.A., Alias, P., Mardan, M. 2012. Morphological Characterization of pollen collected by *Apis dorsata* from tropical rain forest. *International Journal of Botany*, 8 (3):96 – 106.
- Ige, O.E., Modupe, T.O. 2010. Pollen characteristics of honey samples from North Central Nigeria. *Journal of Biological Science*, 10(1):43 – 47.
- Jones, G.D., Bryant, V. M. 2014. Pollen Studies of East Texas Honey. *Palynology*, 38(2):242 – 258. doi: 10.1080/01916122.2014.899276
- Kerkvliet, J.D., Shrestha, M., Tuladhar, K., Manandhar, H. 1995. Microscopic detection of adulteration of honey with cane sugar and cane sugar products. *Apidologie*, 26:131 – 139.
- Louveaux, J., Maurizio, A., Vorwohl, G. 1978. Methods of Melissopalynology. *Bee World*, 59:139 - 153.
- Mirjana S., Mirjana P., Ines, B., Danijela P. 2011. Pollen analysis of honeys from Varaždin County, Croatia. *Turkish Journal of Botany*, 35(5):581 – 587. doi:10.3906/bot-1009-86
- Molan, P.C. 1999. The role of honey in the management of wounds. *Journal of Wound Care*, 8:415 – 418.
- Molan, P.C. 2001. Why Honey is Effective as a Medicine. *Bee World*, 82(1):22 - 40.
- Moore, P. D., Webb, J. A. 1978. *An illustrated guide to pollen analyzes*. Hooder and Stoughtonm, London, pp: 133.
- Mourelle, D., Prieto, A. R. 2016. Pollen and spores from surface samples in the campos region of Uruguay and their paleoecological implications. *Acta Botanica Brasilica*, 30(3):351 - 370.
- Naskar, S. 2016. Taxonomic study of the family: Lamiaceae based on trichome and palynological characters. *Indian Journal of Plant Sciences*, 5(1):111 – 118.
- Njokuocha, R.C., Ekweozor, C.C. 2007. Pollen contents of Commercial honeys of Opi and Nzukka, Enugu State, Nigeria. *Plant Product Research Journal*, 11:5 - 11.
- Omer, K., Mehmet, A.K., Fethi, A.O. 2016. Pollen analysis of honey from the Hizan district of Bitlis province, eastern region of Turkey. *International Journal of Plant, Animal and Environmental Sciences*, 6(1):324 – 331.
- Omoloye, A.A., Akinsola, P.A. 2006. Foraging sources and effects of selected plant characters and weather variables on the visitation intensity of Honeybee, Apis mellifera adansonii (Hymenoptera: Apidae) in the Southwest, Nigeria. *Journal of Apicultural Science*, 50(1):39 - 48.
- Oyeyemi, S.D., Kayode, J. 2012. Pollen analysis of honey derived from Ekiti state, Nigeria. *Bulletin of pure and Applied Sciences*, 31b (1):39 – 47.
- Oyeyemi, S.D., Kayode, J. 2013. Pollen Analysis of *Apis mellifera Honey* Collected from Nigeria. *American Journal of Agriculture and Forestry*, 2(5):226 - 231.
- Oztasan, N., Altinkaynak, K., Akcay, F., Gocer, F., Dane, S. 2005. Effects of 'mad' honey on blood glucose and lipid levels in rats with streptozotocin-induced diabetes. *Turkish Journal of Veterinary and Animal Science*, 29:1093 – 1096.
- Ponnuchamy, R., Bonhomme, V., Prasad, S., Das, L., Patel, P., Gaucherel, C., Pragasam, A., Anupama, K. 2014. Honey Pollen: Using Melissopalynology to Understand Foraging Preferences of Bees in Tropical South India. *PLoS ONE*, 9(7):1 - 11.
- Russmann, H. 1998. Yeasts and glycerin in the production of bleeding hormones: Proof of fermentation. *Food Chemistry*, 52:116 - 117.
- Shubharani, R., Roopa, P., Sivaram, V. 2013. Pollen morphology of selected bee forage plants. *Global Journal of Bio-Science and Biotechnology*, 2(1):82 - 90.
- Song, X.Y., Yao, Y.F., Yang, W.D. 2012 Pollen Analysis of Natural Honeys from the Central Region of Shanxi, North China. *PLoS ONE* 7(11): e49545. doi: 10.1371/journal.pone.0049545

- Sowunmi, M.A. 1976. The potential value of honey in paleopalynology and archaeology. *Review of Palaeobotany and Palynology*, 21:171 - 185.
- Sowunmi, M.A. 1995. Pollen of Nigerian Plants. *Grana*, 34 (2):120 - 141.
- Stawiarz, E., Wroblewska, A. 2010. Melissopalynological analysis of Multifloral honeys from the Sandomeirska Upland area of Poland. *Journal of Apicultural Science*, 54(1):65 – 75.
- Von Der Ohe, W., Oddo, L. P., Piana, M. L., Morlot, M., Martin, P. 2004. Harmonized methods of melissopalynology. *Apidologie*, 35:18 - 25.
- Willard, D.A., Bernhardt, C.E., Weimer, L., Cooper, S.R., Gamez, D., Jensen, J. 2004. Atlas of Pollen and Spores of the Florida Everglades. *Palynology*, 28:175 – 227.