MELISSOPALYNOLOGICAL STUDIES IN INDIA: A REVIEW

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***Abstract*- Melissopalynology is the study of pollen grains in honey. It helps to assess the bee foraging preference of the region by providing the exact information regarding the floral resource to bees. Floral calendar of the concerned area of study can be easily prepared by melissopalynological studies. In the present review, an attempt has been made to assess the work done in India which started in early fifties. Present communication also gives an insight to different plants preferred by honey bees. The present review is also exploring current status and scope in this research area which can help in improving the present situation of honey market in India.**

***Key words*: Honey, melissopalynology, pollen, bee foraging.**

INTRODUCTION

Honey, popularly known as golden liquid,is a natural sweetener that is produced by honey bees by collecting nectar from flowers. From centuries, honey has been consumed as food (Zumla and Lulat, 1990). Honey is a natural product of very high nutritive value which is made when the nectar (floral) and sweet deposits from plants (non-floral) are gathered, modified and stored in the honeycombs by honeybees (Manyi-Loh*et al*., 2011)

Pollen grains are essential food for honey bees as they are source of proteins, vitamins, minerals and fatty substances (Gary, 1975). They are an important tool in analysing honey. For identifying floral nectar sources utilized by honey bees to produce honey, different pollen grains from different plants are used. This helps in labelling of major and minor nectar sources of honey sample (Sadia Bibi *et al*., 2008). For understanding bee foraging preferences of honey bees, it is essentially important to have the basic understanding of the local flora. Most easy and simplest method widely followed by majority of botanists to do so is by performing melissoplaynological studies of the honey samples collected from the desired area.

Qualitative and quantitative analysis of pollen content of honey is melissopalynology (= melittopalynology). This term comes from the Greek words for “bee” and “honey” along with the word for “study of dust,” now referred to “pollen”. Such studies are beneficial in determination of the floral content and origin of honey samples present in a particular geographical area during different seasons. (Parades *et al*., 2020). This method is recognized worldwide as being the least expensive and quickest way to determine the pollen content of honey. Concentration of representative floral pollen in honey is dependent upon several factors such as: structure of flower; size and shape of pollen grains; and how long it spends in the bee’s honey stomach.

Melissopalynological studies have been used to verify honey types produced from floral sources that are “under represented” or “over represented” in the relative pollen counts of the honey samples. Verification of preferred (premium) types of honey is often difficult because many of them come from plant sources that are either weak pollen producers or have pollen that is under-represented in honey (Bryant & Jones, 2001).

Apis dorsata, *Apis cerana* and *Apis mellifera* are the major bee species largely responsible for nectar collection in India (Chauhan *et al*. 2017), though *Apis cerana* indica is most common and utilized in bee keeping apiaries. Study of pollen grains in honey samples helps in identifying the purity of honey. Presence or absence of different pollen types helps in identifying the main plant sources for nectar which in turn can help the native people to encourage apiculture at a larger scale and thereby generating employment opportunities to locals.

During the last few decades, analysis of pollen using honey samples have been reported from districts of Lucknow (Chaturvedi, 2009, Chauhan *et al*., 2013), Western Himalayan Region of Uttar Pradesh (Chaturvedi, 2004), Adikmet area, Hyderabad (Kalpana *et al*., 1990), Prakasam, Andhra Pradesh (Jhansi *et al*.,1991,1994), South Indian Western Ghats (Balachandra, 1999), North Eastern hill region (Singh, 1999), Karnataka (Sivaram ,2001), Maharashtra (Bhusari, 2005), Upper Gangetic Region of India (Datta*et al.*, 2008), Nilgiri Biosphere (Sivaram, 2012), Nadia, West Bengal (Bhattacharya, 2014), Tropical South India (Ponnuchanney*et al.*, 2014), Chandrapur, Maharashtra (Lakshmikant*et al.*, 2014, Borkar*et al.*, 2016), Varanasi, Uttar Pradesh (Sahney*et al.*, 2016), Vindhya Pratishthan Campus, Baramati, Pune (Harugade*et al*., 2016), Chandrapur District, Maharashtra (Borkar and Mate., 2013), Assam (Tripathi, 2017), Kangra, Himachal Pradesh (Saklani, 2017), Garhwal Himalaya, Uttarakhand (Chaudhary *et al.*, 2018), Newasa tehsil, Maharashtra (Dhawan*et al.*, 2018), Nilambar Taluk, Malappuram, Kerala (Divakaran*et al.*, 2019), Dakshina Kannada Karnataka (Krishna and Patil, 2019), Paderu Vishakhapatnam Andhra Pradesh (Devender *et al.*, 2020), Eastern dry zone Karnataka (Kumar, 2020). In the present review work an attempt has been made to sum up the melissopalynological studies by different investigators in different places of India.

History

Author	Area of Study	Dominant Plant Families	Dominant Plant taxa	Economic Uses
Chaturvedi, 2009	Banthra, Lucknow, India	Fabaceae Xanthorrhoeaceae Fabaceae Amaranthaceae Rosaceae Compositeae Rutaceae Linaceae Meliaceae Areacaee	*Cassia abbreviate* Oliv. *Asphodelusacaulis*Desp. *Pisumabyssinium*A. Braun *Chenopodiumacerifolium*Andrz. *Rosa abretina*Gren. Ex. H.Christ *Carthamusarborescens* L. *Citrus assemensis*R.M.Dutta& Bhattacharya *Linumacerticarpum C.M. Rogers* *Melia azedarach* L. *Borassusaethiopium*Mart.	-------
Chauhan *et al*., 2013	Lucknow	Myrtaceae Fabaceae Fabaceae Myrtaceae Sapotaceae Fabaceae Moringaceae Moraceae	*Syzigium cumini*(L.) Skeels *Prosopisjuliflora*(Sw.) DC. *Prosopisspicigera*(L.) *Eucalyptus abdita*Brooker & Hopper *Madhuca indica*J.F. Gmel. *Pithecellobiumdulce*(Roxn.) Benth. *Moringa oleifera* Lam. *Morus alba* L.	----------
Chaturvedi, 1989	Western Himalayan Region of Uttar Pradesh	Brassicaceae Rosaceae Betulaceae Polygonaceae	*Brassicaaucheri*Boiss *Prunus africana* (Hook. f.) *Alnusacuminata*Kunth. *Rumexabyssinicus*Jacq.	----------

Kalpana*et al.*, 1990	Adikmet area, Hyderabad	Anacardiaceae Compositeae Arecaceae Arecaceae Meliaceae Amaranthaceae Acanthaceae Rubiaceae Convolvulaceae Zygophyllaceae Lamiaceae Simaroubaceae Compositeae Fabaceae Boraginaceae Fabaceae Rutaceae Myrtaceae Nyctaginaceae Rubiceae Malvaceae	*Mangifera indica* L. *Tridax procumbens (L.) L.* *Phoenix sylvestris*(L.) Roxb. *Cocos nucifera*L. *Azadirachta indica* A. Juss. *Allmania nodiflora* (L.) *Rungia repens*(L.)Nees. *Oldenlandia umbellata* L. *Evolvulusalsinoides*(L.)L. *Peltophorum ferrugineum* (Decne.)Benth. *Tribulusterrestris*L. *Ocimum americanum*L. *Ailanthus excelsa*Roxb. *Ageratum conyzoides*(L.)L. *Acacia leucophloea* (Roxb.)Willd. *Heliotropiumzeylanicum*(Burm.f.)Lam. *Bauhinia variegata*L. *Citrus limon* (L.) Osbeck. *Eucalyptus globulus*Labill. *Boerhaaviadiffusa*Brandegee *Randia diometorem*(Retz.) Lam. *Bombax malabaricum* DC.	----------

Jhansi *et al*., 1991	Prakasam, Andhra Pradesh	Fabaceae Combretaceae Fabaceae Rutaceae Lythraceae Loganiaceae Rhamnaceae Phyllanthaceae Meliaceae Myrtaceae Fabaceae Fabaceae	*Cassia fistula* L. *Terminalia alata*Wall. *Bauhinia racemosa*Lam. *Feronia elephantum* Correa *Lagerstroemia parviflora*Roxb.*Strychnosp otatorumL.f.* *Zizyphusxylopyrus*(Retz.) Willd. *Phyllanthus acaciodes*Urb. *Soymida febrifuga* (Roxb.) A. Juss. *Syzygiumcumini*(L.) Skeels *Dalbergia latifolia*Roxb. *Caesalpinia bondue*(L.) Roxb.	----------
Jhansi *et al*., 1994	Andhra Pradesh	Lythraceae Fabaceae Sapindaceae Arecaceae Acanthaceae Cucurbitaceae Verbenaceae Cucurbitaceae	*Lagerstroemia parviflora*Roxb. *Crotalaria juncea*L. *Schleichera oleosa* (Lour.) Men. *Borassus flabellifer*L. *Hygrophilaacinos*Heine *Cucumis aculeatus*Cogn. *Phyla nodiflora*(L.) Greene *Momordica charantia*L.	----------

Singh, 1999	North Eastern Hill Region	Acanthaceae Compositeae Brassiceae Ranuncullaceae Compositeae Rubiaceae Solanaceae Rubiaceae	*Adhatodadensifora*Manning *Ageratum albidum*(DC.) Hemsl. *Brassica brachyloma*Boiss. &Reut. *Clematis acerifolia*Maxim *Helianthus agrestis*Pollard *Mussaendaacuminata*Blume *Solanumtubersum*L. *Wendlandia aberrans*F.C. How	Source of pollen, nectar in North Eastern Region
Bhusari, 2005	Maharashtra	Compositeae Compositeae	*Lagascea mollis*Cav. *Parthenium hysterophorus* L.	Region selected for the investigation has good potential for sustaining beekeeping ventures because of the diversity of nectar and pollen taxa.
Datta *et al*., 2008	Upper Gangetic region of India	Brassicaceae Apiaceae Myrtaceae Myrtaceae Polygonaceae Compositae	*Brassica carinata* A.Braun *Coriandrumsativum*L. *Eucalyptus accedens* W. Fitzg. *Callistemonacuminatus*Cheel. *Myricaadenophora*Hance *Rumexabyssinicus*Jacq. *Erigeronabajoensis*Cronquist	Plants useful for apiculture in these regions.

Sivaram,2012	Nilgiri Biosphere	Fabaceae Arecaceae Rubiaceae Malvaceae Euphorbiaceae Araliaceae Sapindaceae Fabaceae Rubiaceae Acanthaceae	*Butea monosperma* (Lam.) Taub. *Cocos nucifera*L. *Coffeaabbayesii*J.F. Leroy *Bombaxalbidicum*Gagneb. *Croton abegii*Urb. & Ekman *Schefflera acaropunctata**Frodin* *Sapindusemarginatus*Vahl *Bauhinia aculeata*L. *Mussaendaacuminata*Blume *Justicia simplex*D.Don	Honeybees are important in terms of pollination of various economically important crops and also to increase farm income through honey and other hive products like pollen, wax, royal jelly and propolis. Pollen analysis in honey of different regions provides information on sources and quality of honey yielding plants.
Chauhan *et al*., 2013	Lucknow, Uttar Pradesh	Fabaceae Menispermaceae Moringaceae Amaranthaceae	*Pithecellobiumdulce*(Roxb.) Benth. *Tinospora cordifolia* (Wild.) Miers. *Moringa oleifera* Lam. *Chenopodium album* L.	----------
Bhattacharya, 2014	Nadia, West Bengal	Compositeae	*Partheniumargentatum*A.Gray	----------
Ponnuchamy et al., 2014	Tropical South India	Anacardiaceae Arecaceae Arecaceae Arecaceae	*Lannea acida* A.Rich *Phoenix acaulis* Roxb. *Borassusaethiopum*Mart. *Cocos acaulis*Drude	----------
Laxmikant*et al*., 2014	Chandrapur, Maharashtra	Fabaceae Asteraceace Lamiaceace Capparidaceace Solanaceace	*Cajanus cajan (L.)* Millsp. *Celosia argentea*L. *Prosopisjuliflora*(Sw.) DC *Hyptis suaveolens (L.) Poit.Capparis grandis*L.f. *Cleome gynandra* L. *Capsicum annuum*L. *Dodonea viscosa*(L.) Jacq.	All these taxa constitute important pollen source during the summer season for the honey bees of this forest area.

Borkar *et al*., 2016	Chandrapur, Maharashtra	Combretaceae Fabaceae Fabaceae Anacardiaceae Myrtaceae Meliaceae	*Terminalia actinophylla* Mart. *Pongamia pinnata* (L.) Pierre *Delonix regia* (Hook.) Ref. *Mangifera indica* L. *Syzygiumcumini*(L.) Skeels *Azadirachta indica*A. Juss.	Maintenance of apiaries in the vicinity of agricultural crops, in additional providing enough harvest of honey, also results in enhanced crop yield as a consequence of higher degree of pollination.
Sahney*et al*., 2016	Varanasi, Uttar Pradesh	Brassicaceae Compositeae Myrtaceae Apiaceae Myrtaceae Caricaceae Rutaceae Fabaceae	*Brassica campestris*L. *Ageratum conyzoides*(L.) L. *Callistemon citrinus*(Cartis) Skeels *Coriandrumsativum*L. *Eucalyptus globulus*Labill. *Carica papaya*L. *Citrus aurantiaca*Swingle *Crotalaria juncea*L.	*Brassica campestris, Coriandrumsativum, Ageratum conyzoides*and *Callistemon citrinus* canberegardedasmajorbeesource plants.
Harugade*et al*., 2016	Vindhya Pratishthan Campus, Baramati, Pune	Meliaceae Anacardiaceae Fabaceae Fabaceae Fabaceae Fabaceae Fabaceae	*Azadirachta indica* A. Juss. *Mangifera indica* L. *Cassia fistula* L. *Cassia occidentalis* L. *Albizia amara* (Roxb.) B. Boiven *Bauhinia aculeate* L. *Prosopisjuliflora*(SW.) DC.	In order to increase honey yield and quality management of honeybee flora and floral calendar is critically important to study area.
Borkar and Mate, 2014	Chandrapur, Maharashtra	Combretaceae Anacardiaceae Asteraceae Rutaceae Fabaceae	*Terminalia actinophylla* Mart. *Mangifera indica L.* *Blumeaadenophora*Franch *Citrus limon* (L.) Osbeck *Delonix regia* (Hook.) Raf.	*Terminalia* sp.constitutesthemajorsourceofpollentothehoneybeesduringthesummerperiod

Tripathi, 2017	Assam, Northeast India	Fabaceae Brassicaceae Apiaceae Rhamnaceae Bombacaceae Fabaceae Fabaceae Meliaceae Fabaceae Lythraceae	*Mimosa pudica* L. *Brassica campestris* L. *Coriandrumsativum*L. *Ziziphus mauritiana* Lam. *Salmaliamalabarica*(DC.) Schott & Endl. *Cassia fistula* L. *Acacia catechu*(L.f.) Willd. *Toona ciliata* M. Roem. *Butea monosperma* (Lam.) Taub. *Lagerstroemia parviflora* Roxb.	Melissopalynological investigation may contribute to and favor the possibilities of using rich flora of the studied area in order to develop beekeeping enterprises on a commercial basis, in which self-employ-ment opportunities may be created for many disadvantaged communities in the state.
Saklani, 2017	Kangra, Himachal Pradesh	Rutaceae Fabaceae Fabaceae	*Citrus grandis*(L.) Osbeck *Acacia catechu*(L.F.) Willd. *Bauhinia variegata*L.	To create flora of multipurpose nature which will boost the beekeeping on large scale, to provide part-time or full time employment in rural areas of hilly states, to improve rural economy through enhancing the monetary and self-employment opportunities.
Chaudhary *et al.*, 2018	Garhwal Himalaya, Uttarakhand	Rosaceae Rosaceae Rosaceae Rosaceae	*Prunuscerasoides*Buch.-Ham ex D. Don *Prunus persica*(L.) Batsch *Pyrus pashia* Buch.-Ham.ex D. Don *Rosa brunonii*Lindl	The present study is useful in the development of the analytical standard for further studies on pollen chemistry.

Dhawan*et al.*, 2018	Newasa Tehsil, Maharashtra	Amaranthaceae Compositeae Fabaceae Fabaceae Fabaceae Amaranthaceae Convolvulaceae Moringaceae	*Alternanthera sessilis* (L.) R. Br. ex. D.C. *Partheniumargentatum*A.Gray *Cassia bicapsularis* (L.) Roxb. *Cassia tora* L. *Pongamia pinnata* (L.) Pierre. *Celosia argentea* L. *Ipomoea hederifolia*L. *Moringa oleifera* Lam.	The pollen grain from honey can be used for the taxonomic identification of honey yielding plants.
Divakaran et al., 2019	Nilambar taluk, Malappuram, Kerala	Fabaceae Malvaceae Arecaceae Euphorbiaceae Cucurbitaceae Fabaceae Malvaceae Anacardiaceae Fabaceae Fabaceae Moringaceae Passifloraceae Fabaceae Sapindaceae Bignoniaceae Fabaceae Arecaceae Rubiaceae Myrtaceae	*Acacia auriculiformis*Benth. *Bombax ceiba* L. *Cocos nucifera*L. *Croton abaitensis* Baill. *Cucurbita andreana* Naudin *Delonix regia* (Hook.) Raf. *Hibiscus rosa-sinensis* L. *Mangifera indica* L. *Mimosa invisia* Coll. *Mimosa pudica* L. *Moringa oleifera* Lam. *Passiflora foetida* L. *Peltophorum pterocarpum* (D.C.) K. Heyne *Schleicheraoleosa*(Lour.) Merr. *Tecoma stans*(L.) Juss. ex Kunth. *Vicia faba*L. *Areca catechu*L. *Ixora coccinea*L. *Psidiumguajava*L.	Increased pollen density of honey indicates the frequent visit of plants by honey bees and the more number of plant species in that area.
Krishna &Patil, 2019	Dakshin Kannada, Karnataka	Arecaceae Arecaceae Rubiaceae Fabaceae Myrtaceae	*Areca catechu* L. *Cocos nucifera*L. *Ixora coccinea* L. *Mimosa pudica* L. *Psidiumguajava*L.	Lesser types of pollen in each honey sample indicates that their food resources are getting limited.

Layek et al., 2020	Southern West Bengal	Brassicaceae Myrtaceae Arecaceae Pedaliaceae Fabaceae Apiaceae Arecaceae Arecaceae Compositae	*Brassica nigra* (L.) K. Koch *Eucalyptus globulus*Labill. *Borassus flabellifer*L. *Sesamum indicum* L. *Acacia auriculiformis*Benth. *Coriandrumsativum*L. *Cocos nucifera*L. *Phoenix sylvestris* (L.) Roxb. *Mikania scandens* (L.) Willd.	Number of pollen forag- ers and the ratio of pollen foragers to total incoming foragers significantly differed according to time of day as well as season and greatly depends on resource availability.
Kumar, 2020	Eastern Dry Zone, Karnataka	Myrtaceae Areacaceae Rutaceae Euphorbiaceae Arecaceae Myrtaceae Lamiaceae Moringaceae Fabaceae	*Callistemon viminalis*(sol. ex Gaerth.) G. Don. *Areca catechu* L. *Citrus grandis* (L.) Osbeck. *Mallotusphilippensis*(Lam.) Mull. Arg. *Cocos nucifera*L. *Eucalyptus globulus*Labill. *Ocimum sanctum* L. *Moringa oleifera* Lam. *Pongamia pinnata* (L.) Pierre	Study will in-turn contribute to the conservation of bees, apiary development and leads to sustainable honey production.

Melissopalynological studies in India

Melissopalynological studies by different investigators in different places of India can be summed up together in a following manner:

a.Trans-Himalayan Region and Himalayan Zone

Chaturvedi (1989) and Chaudhary et al. (2018) conducted Melissopalynological studies in the Western Himalayan Region of Uttar Pradesh and Garhwal Himalaya (Uttarakhand) respectively. Their research revealed that Brassicaceae, Rosaceae, Betulaceae, and Polygonaceae are the dominant plant families in these regions. The preferred plant species for honeybees were identified as *Brassica aucheri* Boiss, *Prunus africana* (Hook. f.), *Alnus acuminate* Kunth., and *Rumex abyssinicus* Jacq. in the Western Himalayan Region of Uttar Pradesh and Garhwal Himalaya, as reported by Chaturvedi (1989). Chaudhary et al. (2018) reported Rosaceae as the dominant plant family, and the preferred plant species for honeybees in Garhwal Himalaya, Uttarakhand were identified as *Prunus cerasoides* Buch.-Ham ex D. Don, *Prunus persica* (L.) Batsch, *Pyrus pashia* Buch.-Ham ex D. Don, and *Rosa brunonii* Lindl. In a separate study by Saklani (2017) in Himachal Pradesh, Rutaceae and Fabaceae were identified as the preferred plant species for honeybees.

b. Western Ghats, Deccan Plateau and Coastal Regions

Kalpana *et al.*(1990 have) reported Anacardiaceae, Compositeae, Arecaceae, Meliaceae, Amaranthaceae, Acanthaceae, Rubiaceae, Convolvulaceae, Zygophyllaceae, Lamiaceae, Simaroubaceae, Compositeae, Fabaceae, Boraginaceae, Rutaceae, Myrtaceae, Nyctaginaceae, Rubiceae, Malvaceae as the dominant plant families preferred by honey bees in Hyderabad. Jhansi et al. (1991,1994) conducted similar studies in Andhra Pradesh. They have observed that Fabaceae, Combretaceae, Rutaceae, Lythraceae, Loganiaceae, Rhamnaceae, Phyllanthaceae, Meliaceae, Myrtaceae, Sapindaceae, Arecaceae, Acanthaceae, Cucurbitaceae, and Verbenaceae as dominant plant families in the region. Bhusari (2005), Laxmikant*et al*. (2014),Borkar *et al*. (2016),Borkar and Mate (2014) and Dhawan *et al*., (2018) have carried out extensive studies in Maharashtra region.Fabaceae, Asteraceace, Lamiaceace, Capparidaceace, Solanaceace, Combretaceae, Anacardiaceae, Myrtaceae, Meliaceae, Combretaceae, Rutaceae, Amaranthaceae,

Compositeae, Convolvulaceae and Moringaceae have been reported as the dominant plant families. Krishna and Patil, (2019) and Kumar(2020) studied the Karnataka region and reported Arecaceae, Rubiaceae, Fabaceae, Myrtaceae, Rutaceae, Euphorbiaceae, Lamiaceae and Moringaceae as the dominant plant families. Divakaran et al. (2019), Sivaram (2012) and Ponnuchamy et al., (2014) studied the tropical South Indian region and reported Fabaceae, Malvaceae, Arecaceae, Euphorbiaceae, Cucurbitaceae, Anacardiaceae, Moringaceae, Passifloraceae, Sapindaceae, Bignoniaceae, Rubiaceae, Myrtaceae, Araliaceae and Acanthaceae as the important plant families for melissopalynological studies. Harugade et al.(2016) reported Meliaceae, Anacardiaceae and Fabaceae as preferred plant families for melissopalynological studies.

c. Gangetic Plains

Chaturvedi (2009) and Chauhan et al.(2013) studied Lucknow region for melissopalynological studies. They have reported Fabaceae, Xanthorrhoeaceae, Amaranthaceae, Rosaceae, Compositeae, Rutaceae, Linaceae, Meliaceae, Arecaceae, Myrtaceae, Sapotaceae, Moringaceae, Moraceae, Menispermaceae as the preferred plant families by honey bees. Datta et al.(2008) reported Brassicaceae, Apiaceae, Myrtaceae, Polygonaceae and Asteraceae as the preferred plantfamilies in the Upper Gangetic Region. Sahney et al.(2016) studied the Varanasi region and reported Brassicaceae, Compositeae, Myrtaceae, Apiaceae, Caricaceae, Rutaceae and Fabaceae as the important plant family for nectar collection by the bees. Bhattacharya (2014) and Layek(2020) reported Brassicaceae, Myrtaceae, Arecaceae, Pedaliaceae, Fabaceae, Apiaceae and Compositeae as the important plant families for melissopalynological studies in West Bengal region.

d. North-East Region

Tripathi (2017) undertook melissopalynological studies in Assam and reported Fabaceae, Brassicaceae, Apiaceae, Rhamnaceae, Bombacaceae, Meliaceae and Lythraceae as the important plant families for collection of pollen by bees.

Current status and future prospects:

Melissopalynological studies in India have been conducted by various scientific groups since the early 1990s, contributing significantly to our understanding of bee foraging plant families in different states and seasons. These studies have played a crucial role in advancing apicultural knowledge. However, there are still gaps in the data, particularly in certain biogeographic zones of the country and the analysis of physicochemical components of honey. Addressing these gaps is necessary to further enhance the Indian apicultural market and establish a scientifically controlled honey market in the country.

To achieve these goals, it is essential to develop a comprehensive dataset adhering to internationally recommended standards for honey. This standardized data can greatly contribute to the advancement of apiculture knowledge and facilitate the growth of the Indian apicultural industry. By meticulously collecting and analyzing data on various aspects of honey production, including plant species, geographical locations, and physicochemical properties, researchers can establish a robust foundation for the apicultural sector in India.

Such a thorough and standardized dataset will provide valuable insights into the diverse bee foraging plant families across different regions and seasons. It will enable beekeepers and stakeholders to make informed decisions about beekeeping practices, honey production, and marketing strategies. Moreover, this wealth of information will foster collaborations between scientists, beekeepers, and policymakers, driving innovation and sustainable development in the apicultural sector.

In conclusion, building a comprehensive and internationally recognized database of honey production standards is essential for the growth of the Indian apicultural market. By addressing the existing data gaps and following recommended standards, India can enhance its apicultural knowledge, improve the quality of honey produced, and foster the development of a scientifically regulated honey market.

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