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Pollen Analysis of Honey Collected from Hingoli District (Maharashtra) India.

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ABSTRACT

A pollen analysis of honey provides a basic information for identifying the origin of a honey in terms of locality and floral resources. This information may be used to develop analytical standards and contributing to quality control of a honey. Qualitative and quantitative analysis of pollen contents of honey samples was undertaken during the year 2017-2019. *Moringa oleifera, Pongamia pinnata, Syzygium cumini, Tamarindus indica and Terminalia* Sp. pollen types were dominantly represented in honey samples of the region. The other major pollen types found were *Aegle marmelos, Albizia* Sp., *Bauhinia* Sp., *Brassica campestris, Cajanus cajan, Cassia siamea* and *Eucalyptus globulus.* The honey samples collected from the region is found to be as multifloral showing a diverse pollen taxon.

Keywords: Pollen analysis, Honey, Hingoli, Maharashtra.

INTRODUCTION

Pollen analysis studied under the branch Melissopalynology, which is valuable tool for the identification of the botanical and geographical origin of honey sample. These pollen analytical studies provide information of resources of bee. During evolution, a special relationship has been developed between the plants and the bees. The flower provides pollen and nectar as a food to visiting bees while the bees while wandering from flower to flower provide a vehicle for pollen transfer leading to pollination. Pollen is a major source of proteins, fatty substances, minerals and vitamins for the honey bees. Bees deliberately collect the pollen grains to fulfill their protein requirement and store them in pollen chambers in the hive (Bhattacharya *et al,* 2006). Furthermore, pollen provides proteins for bees required for building their body tissues especially during early embryonic growth (Agashe, 2006).

Honey is regarded as an important food and medicine throughout the world. Honey bee utilizes certain natural raw materials, pollen and nectar from flowers of various plants and convert it into honey.

Pollen is a convenient food source which requires a minimum of adaptations on the part of the users, almost every insect may use it (Dafni, 1992). Pollen grains contain number of metabolites which are essential for different physiological and metabolic activities during growth and development of the pollen (Stanley and Linskens, 1974). The analysis of honey can help to determine changes in nectar and pollen sources and may help determine the causes of this decline (Gretchen, 2014). India being a country of varied geography climatic condition at a time with different parts in full of a flora ideal for apiculture. It is essential to study relationship between regional flora and honey bees in order to obtain maximum production of a good quality of honey.

Honey bees collect nectar and pollen from the flowers that provide the nutrients necessary for colony maintenance and development. Nectar is processed to form honey, the major energy source for the colony. Pollen is a source of protein and amino acids for the colonies. The quantity and quality of pollen collected by honey bees affects the reproduction, brood rearing and longevity, thus ultimately the productivity of the colony (Kleinschmidt and Kondos, 1978).

Apart from small quantities in nectar, honeybees obtain all the essential nutrients which they need for brood rearing and adult growth and development from pollen grains (Baker and Baker 1983). The pollen grains serve as a food for the brood of honey bees and other insect pollinators (Day *et al*, 1990). The proportion of these nutrients can vary widely amongst the pollen grains of different plant species (Roulston and Cane, 2000).

During the present investigation, twelve different pollen types which were dominantly represented by local honey samples; were undertaken for pollen assessment. The objective of the study is to know the different pollen types present in the Honey and to know its relevance with foraging behaviour of Honey bee.

MATERIALS AND METHODS

Pollen Analysis of Honey

A critical microscopic study has been carried out. The sample were collected from different villages of Hingoli District considering diverse floristic and geographical region. Honey samples were collected from colonies of *Apis dorsata* (Indian Wild Bee) located at different forest and agricultural sites of Hingoli District (MS), India during the period October 2017 to December 2019. The analysis of Honey samples was undertaken for dominantly represented pollen types (Louveaux *et al*, 1978). Honey samples were analyzed and slides were prepared (Arora and Modi, 2008).

The total pollen count was expressed in pollen percentage frequency (PPF) based on the qualitative analysis. To determine the botanical origin of honey and the percentage of different pollen types, qualitative and quantitative analysis was carried out (Louveaux *et al,* 1978; Maurizio, 1951). Pollen preparation was made and observed under the microscope for morphological characterization (Erdtman, 1960; Nair, 1960). The pollen frequency classes are determined as Predominant pollen (more than 45%), secondary pollen (16-45%), important minor pollen (3-15%) and minor pollen (less than 3%.).

OBSERVATIONS AND RESULTS

The honey samples collected from the region is found to be as multifloral showing a diverse pollen taxon. Total 35 pollen types were identified and some are recognized as Asteraceae and Poaceae type. The pollen types reported of which 10 are fruit crops, 7 are vegetables, 3 are pulses, 2 are oil yielding plants, 1 fibre crop, 1 is ornamental, 7 are wild forest plants and remaining 4 are weeds. *Moringa oleifera, Pongamia pinnata, Syzygium cumini, Tamarindus indica and Terminalia* Sp. pollen types were dominantly represented in honey samples of the region. The other major pollen types found were *Aegle marmelos, Albizia* Sp., *Bauhinia* Sp., *Brassica campestris, Cajanus cajan, Cassia siamea* and *Eucalyptus globulus.*

The pollen frequency classes are determined as Predominant pollen (more than 45%), secondary pollen (16-45%), important minor pollen (3-15%) and minor pollen (less than 3%.). The honey samples were subjected to pollen analysis, in which five pollen types were identified as primary dominant types and seven types were considered as secondary types (Table 1). In the present study work, there is no pollen count as minor (less than 3%.).

Table 1: Analysis of Honey and Pollen types in different frequency classes.

S. N.	Date of Collection of Honey Samples	No. of Samples Collected	Site of Collection	Pollen types in different frequency classes		
				Primary (Above 45%)	**Secondary (16 – 45%)**	**Important Minor (3-15%)**
1.	08/10/2017	02	Ridhora Tq. Sengaon	--	*Moringa oleifera*	*Tagetes erecta*, *Ziziphus jujuba*
2.	22/10/2017	03	Bhandegaon Tq. Hingoli	--	*Moringa oleifera*	*Parthenium hysterophorus*
3.	19/11/2017	01	Sengaon	--	*Brassica campestris*	*Tagetes erecta*, *Ziziphus jujuba*
4.	26/11/2017	02	Basamba Tq. Hingoli	--	*Brassica campestris*	*Eucalyptus globulus*, *Coriandrum sativum*
5.	17/12/2017	03	Kalamnuri	*Tamarindus indica*	*Brassica campestris*, *Eucalyptus globulus*	*Allium cepa*, Asteraceae type, Poaceae type
6.	25/12/2017	04	Yelegaon Tq. Aundha	--	*Brassica campestris*	Asteraceae type, Poaceae type
7.	21/01/2018	03	Isapur Tq. Hingoli	--	*Eucalyptus globulus*	*Allium cepa*, *Tridax procumbens*, *Trigonella foenum*, *Brassica campestris*
8.	18/02/2018	03	Malegaon Tq. Kalamnuri	*Pongamia pinnata*	*Bauhinia* Sp., *Brassica campestris*	*Azadirachta indica*, *Carica papaya*, *Mangifera indica*
9.	11/03/2018	02	Limbala Tq. Hingoli	--	*Cassia siamea*, *Pongamia pinnata*,	*Allium cepa*, *Azadirachta indica*, *Mangifera indica*, *Phyllanthus emblica*
10.	30/04/2018	01	Narsi Tq. Sengaon	*Moringa oleifera*	*Albizia Sp.*, *Cassia siamea*, *Pongamia pinnata*, *Syzygium cumini*	*Allium sativum*, *Coriandrum sativum*, *Tamarindus indica*
11.	13/05/2018	02	Selsura Tq. Kalamnuri	Terminalia Sp.	*Aegle marmelos*, *Cassia siamea*, *Pongamia pinnata*, *Syzygium cumini*, *Albizia* Sp.	*Allium sativum*, *Phyllanthus emblica*, *Punica granatum*, *Tamarindus indica*
12.	24/06/2018	03	Kalgaon Tq. Hingoli	--	*Cassia siamea*	*Annona squamosa*, *Cassia tora*, *Psidium guajava*
13.	08/07/2018	04	Digras Tq. Aundha	--	*Cassia siamea*	*Annona squamosa*, *Coriandrum sativum*
14.	22/08/2018	04	Jadgaon Tq. Hingoli	--	*Cajanus cajan*	*Cucurbita pepo*, *Gossypium* Sp., *Vigna mungo*
15.	20/09/2018	03	Yeli Tq. Hingoli	--	*Cajanus cajan*	*Amaranthus* Sp., *Pisum sativum*, *Vigna mungo*, Poaceae type
16.	14/10/2018	01	Lasina Tq. Kalamnuri	--	*Moringa oleifera*	*Tagetes erecta*, *Ziziphus jujuba*
17.	20/11/2018	02	Pimparkhed Tq. Hingoli	--	*Brassica campestris*, *Moringa oleifera*	*Solanum melongena*, *Coriandrum sativum*, Asteraceae type
18.	23/12/2018	01	Khanapur Tq. Hingoli	*Tamarindus indica*	*Brassica campestris*	Asteraceae type, Poaceae type
19.	13/01/2019	02	Nandapur Tq. Kalamnuri	--	*Brassica campestris*, *Tamarindus indica*	*Allium cepa*, *Tridax procumbens*, *Trigonella foenum*, Poaceae type

20.	17/02/2019	04	Aundha (Nag.)	*Moringa oleifera*	*Bauhinia* Sp., *Brassica campestris, Pongamia pinnata*	*Allium cepa, Azadirachta indica, Eucalyptus globulus, Mangifera indica*
21.	03/03/2019	03	Pimpalkhuta Tq. Hingoli	--	*Bauhinia* Sp., *Cassia siamea, Pongamia pinnata*	*Allium sativum, Azadirachta indica, Carica papaya*
22.	07/04/2019	03	Balsond Tq. Hingoli	*Syzygium cumini*	*Albizia* Sp., *Cassia siamea, Pongamia pinnata, Tamarindus indica*	*Allium sativum, Coriandrum sativum*
23.	05/05/2019	02	Andharwadi Tq. Hingoli	*Pongamia pinnata*	*Albizia* Sp., *Aegle marmelos, Cassia siamea, Pongamia pinnata, Syzygium cumini, Terminalia* Sp.	*Allium sativum, Punica granatum, Solanum melongena*
24.	23/06/2019	01	Bhirda Tq. Hingoli	--	*Cassia siamea*	*Moringa oleifera, Punica granatum*
25.	07/07/2019	01	Kothalaj Tq. Hingoli	--	*Cassia siamea*	*Cassia tora, Glycine max*
26.	25/08/2019	02	Yelegaon Tq. Kalamnuri	--	*Cajanus cajan*	*Annona squamosa, Cucumis sativus*
27.	29/09/2019	01	Korta Tq. Basmath	--	*Cajanus cajan*	Amaranthus Sp.
28.	20/10/2019	02	Lohgaon Sq. Sengaon	--	*Moringa oleifera*	Asteraceae type
29.	24/11/2019	03	Malhivara Tq. Hingoli	*Moringa oleifera*	*Brassica campestris*	Asteraceae type
30.	08/12/2019	03	Chincholi Tq. Hingoli	--	*Brassica campestris, Tamarindus indica*	Parthenium hysterophorus, Asteraceae type

DISCUSSION

The area of study was under the cultivation of agro-horticultural crops and covered with wild plantation. Honey bee are the essential elements of crop ecosystem by pollinating wide range of crops. Pollen spectra of the regional honey samples varied according to the vegetation type utilized by the bees within the floristically diverse regions. Some of the pollen types were considerably observed to serve as important nectar and pollen sources to honey bees. From the pollen spectra it was observed that Hingoli district includes both naturalized flora as well as cultivated crops. The investigation revealed that in addition to already known bee forage (e.g. *Brassica, Coriandrum* and *Moringa*) some other species including *Syzygium cumini* and *Pongamia pinnata* were also heavily utilized as pollen and nectar sources by honey bees from this region. The agricultural crops like *Vigna mungo*, *Gossypium* sp. and *Cajanus cajan* were also found to be very useful food resources for honey bees. As the pollen grains are having nutritional value, the honey bees collect them as a source of proteins. Pollen grains are collected by honey bees from a wide range of floral species. Pollen load provides valuable floral nutrients and food demand of visitor.

In Indian honeys, the major pollen types exploited by *Apis dorsta* species. The honey bee *A. dorsata* is a voracious forager, collect nectar and pollen from diversified flora and produce multifloral honey. Understanding its floral source would help reveal floral status of the region and knowledge on pollen types would provide a greater insight into Melissopalyonology of the region (Bhargava *et al*, 2009; Raghunandan and Basavarajappa, 2014). Similar observations found from the region. There was a dominance of tree species which are the most preferred and highest contribution for nectar and pollen source for honeybees (Sivaram *et al,* 2012). Bhusari *et. al.* 2005, earlier revealed similar findings during study of Honey samples of Maharashtra.

Pollen is a source of proteins, lipids and vitamins which are essential to growth and development of honey bees rather than energy production (Roulston and Cane, 2000). Since the time of Aristotle, it has been written that honeybees show remarkable fidelity to a plant species when visiting a patch of flowers to forage. This pollinator-flower constancy, in fact, is not limited to a few flowers in a set of sequentially visited flowers. The legendary flower fidelity of honeybees actually arises for different reasons. Like many other species, honeybee flower fidelity can arise from energetic considerations involving nectar reward quality, quantity or work considerations.

Frequent and moderate visit on flower clear that honey bees preferred all the plants as major food source. To improve the beekeeping industry, a proper understanding and mutualism between bees and available plant taxa in the region and in a particular season is necessary (Bhusari *et. al.,* 2005). It was observed that different fruits, vegetables, pulses, oilseed crops, fiber crops, ornamental plants and wild plants species were the supplier of nectar and pollen in natural and crop ecosystem. Similar findings were recorded by Pande and Ramkrushna (2018) from Nagpur and Wardha Districts of Maharashtra.

Present Investigation revealed the presence of good potentials of pollen from honey samples. It indicates that bee used pollen grains from flowers for a growth of colony nectar source in honey would help beekeepers maintaining their colonies (Kumar and Jagtap,1998). Bees used pollen for brood rearing, growth in colony strength, and nectar for their carbohydrate requirement. The identification of pollen and nectar sources in honey would help beekeepers in maintaining their colonies (Rakesh Kumar and Jagtap, 1988).

The region selected for the present study has good potential for sustaining beekeeping ventures because of the diversity of nectar and pollen taxa. Since *Moringa oleifera*, *Tamarindus indica Terminalia* Sp. and other major sources of forage for honey bees, efforts should be made to increase their cultivation as well as plants in the families Asteraceae, Poaceae, Euphorbiaceae, Rutaceae and Fabaceae in these areas. The identified taxons were not only the economic crops but also play an important role in the development of beekeeping in these areas.

CONCLUSION

The visits of honey bees to the flowers of particular taxa is seen in present investigation. These data reflect the floral situation of the region and reason for particular honey was produced. The identification of geographical origin based on the presence of a combination of pollen types of this area, is benefit of the study. The region selected for the present study has good potential for sustaining beekeeping ventures because of the diversity of nectar and pollen taxa. The economically important plants constitute major part of the flora of this area. There is potential to produce considerable quantity of honey from these sources. *Moringa oleifera, Pongamia pinnata, Syzygium cumini, Tamarindus indica and Terminalia* Sp. pollen types were dominantly represented in honey samples of the region.

Conflicts of Interest: The authors declare no conflict of interest.

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