Pollen Foraging Behaviour of *Apis dorsata* at the onset of spring in Lucknow, Uttar Pradesh, India

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**ABSTRACT**

Honey is the natural sweet produced by honeybees from nectar and other secretions of plants. Honeybees not only collect nectar but also pollen that forms an integral part of their diet. House bees collect the nectar from the stomach of the worker bees followed by enzymatic action that ripens the nectar into honey. In the foregoing study gut analysis of *Apis dorsata* collected from Lucknow, Uttar Pradesh is done to study pollen load present therein. Reverse mellisopalynological analysis during early spring reflects the floral resource that makes up the dietary habit of the bee. Syzygium cumini forms the dominant grain in the pollen load recovered from the mid gut. This qualitative approach throws light on the bee flora of the region and can be utilized for the regional potential for apiary industries.

**KEYWORDS**

*Apis dorsata*, Honey, Pollen, Reverse Mellisopalynology

**HOW TO CITE THIS ARTICLE**


Codex Alimentarius (1988) system describes honey as the “natural sweet substance produced by the honey bees from the nectar of plants or from secretions of living parts of plants, or excretions of plant-sucking insects on the living parts of plants, which the bees collect, transform by combining with specific substances of their own, deposit, dehydrate, store and leave in honeycombs to ripen and mature.” Honey is produced by the combined activities of worker and house honey bees, the former one is assigned with the job of collecting nectar and pollen while the latter is responsible for the enzymatic activity that eventually ripens the nectar to honey in the bee hive. Pollen forms an important constituent in the diet for honeybees, aiding in their survival and reproduction. Significant correlation has been observed in the pollen foraging behaviour of honey bees with its age and activities (Dietz, 1978; Eischen *et al.*, 1984; Crailsheim *et al.*, 1992; Hrassnigg and Crailsheim, 1998; Naiem *et al.*, 1999; Loidl and Crailsheim, 2001). In the Indian subcontinent, honey is principally obtained by the activities of the *Apis dorsata* and *Apis florea*. The worker bees gather nectar and pollen with their long tube like tongues from flowering plants as their food (fig 1). It is stored in their honey stomach and may store a maximum of about 70 mg of nectar. Post this the house bees collect the nectar from the stomach of the worker bees. They chew it for further enzymatic action ripens the nectar into honey. The pollen load is transferred to the midgut where digestion and absorption occurs, finally to rectum before defecation occurs (Seeley, 1995). Besides, nectar honey bees also collect pollen loads during the act of pollination. This gives us a picture of the vegetation that was most recently visited by the swarm. Primarily, the pollen content of honey is analysed for the mellisopalynological purpose. It provides with a picture of the botanical and geographical source of the honey. However, there is always a chance of fungal growth in case of stored honey in the hives as well as anemophilous palynomorphs are also often encountered which are otherwise not gathered by the bees in course of nectar and pollen collection. Hence the analysis of pollen load from the gut of honey bee is a much more authenticated technique for knowing the plant preference of honey bees. It reveals to us the specific pollen preference and hence the foraging behaviour of honey bee. In the recent past a good deal of work has been successfully conducted on pollen content of honey from various parts of India, including Uttar Pradesh (Chaturvedi and Shrama, 1973; Chaturvedi, 1976; Chauhan and Singh, 2010; Chauhan and Trivedi, 2011; Chauhan *et al.*, 2013).
Mostly mellisopalynological study involves the pollen analytical study of honey from the bee hives or apiaries. However analysis of the pollen gut provides us with the direct evidence of flora most commonly visited by the honeybees is lacking. So far this type of study i.e. reverse mellisopalynology has been practiced seldom from abroad \(^{13-15}\), however this type of study is sincerely lacking in the Indian perspective. This type of study provides us with the idea of identifying the local vegetation surrounding the beehive. We can also correlate between the seasonal variations in pollen foraging behaviour of honey bee. Since, vegetation of an area is a direct product of the prevailing climate and rainfall; hence the feeding habit of herbivores is also a factor dependent on climate. Therefore, we have tried in tracing down the pollen foraging behaviour of *Apis dorsata* at the onset of spring season. During this season, vegetation of Lucknow is characterised by the predominance of species such as *Cassia, Syzgium, Eucalyptus, Crotalaria*, etc.

**MATERIALS AND METHODS**

The pollen load of the bees were carefully collected directly from the body of worker bees under simple microscope, they were partially digested in 45% HNO\(_3\) for 3 days to dissolve the tissue remains. This was followed by carefully washing in distilled water to remove the acid traces. The residue was acetylised by the standard Acetolysis method using Acetolysis mixture (9:1:: Acetic Anhydride: Concentrated H\(_2\)SO\(_4\)), followed by several washings with glacial acetic acid and distilled water (Erdtman, 1969). The acetylated residue was stored in 50% glycerine with a drop of phenol for microscopic observation. Approximately, 300 pollen counts were made under magnification of 400X in light microscopy to minimise the error arising out of uncertainty. Pollen was identified with the available literature and the number of grains of each type were analyzed to procure qualitative and quantitative pollen spectrum of the pollen load.

**RESULTS AND DISCUSSION**

Analysis of the pollen load suggests that the load is mixed in nature with fair representation of the floras blooming at the particular season of collection. *Syzgium cumini* pollen forms the predominant pollen type, accounting approximately 43% of the total pollen count. The assemblage is sub dominated by the pollen of *Cassia mimosoides* and *Crotalaria*. *Smithia, Eucalyptus, Holarrhena* and *Moringa* are fairly represented (2-5%) in the present studied pollen load. Spring is the season of plenty when local flora blooms into full population and the presently studied pollen load recovered from the gut is represented by 14 genera. Important genera that were being recovered and studied from the pollen load is represented by *Syzgium cumini, Crotolaria, Eucalyptus, Cassia mimosoides*, etc (Fig. 2). The highest representation is by the genera of *Syzgium cumini* (42.23%), followed by *Cassia mimosoides* (24.25%), *Crotolaria* (15.53%), *Eucalyptus* (4.36%), *Smithia sesetiva* (3.54%), *Holarrhena* (2.18%), *Moringa* (2.45%), etc. (Fig. 3).

**CONCLUSION**

This type of study reflects a broader use of floral resource that makes up the dietary habit of the bee. This type of data can be utilized for the preparation of apiaries, since we get the direct evidence of the plant species range that occur in the region which are utilizable to the bees for the purpose of honey making. Overwhelming dominance of *Syzgium* from the pollen load suggests its direct beneficiary role in the growth and life cycle of honey bee. Growing plants which are utilizable to honey bees for the preparation of honey will open up the avenue of bee pasturage in the region. Regional vegetation study through pollen load analysis reveals the regional potential for apiary industries. The present study reflects that at the onset of spring, bees preferably forage on the above mentioned specific group of plants. The analysis reveals that unifloral honey is the characteristic feature of the spring honey of Lucknow region. The high percentage spectra of *Syzgium* pollen reflects that the vicinity of the hive near or on the *Syzgium* tree itself. This type of study reflects the qualitative information regarding the bee flora of the particular region. For quantitative study, pollen pellet analysis can be utilized.
Fig. 1. Worker *Apis dorsata*, the collector of nectar and pollen from flowers (Scale bar = 1 mm).


Fig. 3. Statistical representation of the different genera of pollen grain recovered from the pollen load.
REFERENCES


