

# Temporal Variation in Nectar Concentration and pH in Flowering Plants of Ecopark, Kolkata, West Bengal

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**Abstract:** *Biotic pollination influences interdependence between plants and animals, where nectar represents a reward for the pollinator to make them an apparent target. This study was to understand the temporal variation in nectar concentration and pH of flowers in the Urban park of Ecopark. This study was conducted from February 2024 to March 2024 during the spring season in an urban park named Eco Park located in Newtown, Kolkata of West Bengal, to observe the difference in nectar concentration of flowers on a temporal scale. A total of 11 different species of flowers were examined, where Powder Puff, Pink Morning Glory, Glory tree, Crown flower and African Tulip showed a significant range in Brix value. While China Rose, Jungle Flame, Rangoon Creeper, Bastard Teak, Common Lantana and Ashoka indicated a stabilized range throughout the day. Among the 11 species, nectar concentration peaked during the Afternoon, reflecting an optimal timing for pollination and nectar collection. The assessment of Nectar pH indicated acidic in nature, though the African Tulip being an exception with mild basic pH. Further, looking into the variations of nectar concentrations may give an overall idea of optimal concentration for pollination and its peak hours for different species.*

**Keywords:** Nectar concentration, Temporal variation, Brix value, Nectar pH.

## 1. Introduction

Biotic pollination represents mutualism and a source of interdependence between plants and animals in terrestrial ecosystems [17]. And for this perpetual process, floral nectar represents the main plant reward to attract pollinators, making them an ostensible target [1]-[3], [6], [10]. Nectar contains one disaccharide (sucrose) and two hexoses (glucose and fructose). Since different pollinators show preferences for different solutions with varying viscosity with sugar composition [1], [12], [16], therefore, they are supposed to differ among different taxa but nectar characteristics do have high conservative traits as mentioned by other authors. Even due to close phylogenetic relationship, some species which are different in pollinator type may show similar nectar sugar composition ([5], [7]-[9], [14], [18]). Nectar concentration is highly impacted by environmental factors like temperature, humidity and precipitation [11]. Nectar-seeking pollinators often associate floral cues with the volume and concentration of nectar as a profitable gain or 'net energy gain'. With time, they may learn to associate with flowers, providing nectars with more

sugar concentration as a more profitable reward [4]. With variations in floral structure, the type of pollinators and the nectar concentration also change [13]. In this study, the temporal variation in nectar concentration and pH of flowers were recorded in Ecopark to understand how environmental factors affect or influence biotic pollination, as well as pollinators.

## 2. Materials and Methods

### 2.1. Study Area

Ecopark is a representative example of a large urban park, encompassing a total land area of 194 hectares. This park has diverse habitats and features a substantial water body spanning 42 hectares, which is accompanied by several islands inside its boundaries. Located inside the confines of the Ecopark, Pakhibitan represents a diminutive expanse of natural habitat that has been subject to minimal human intervention. This characteristic renders it a suitable ecological niche for various taxa.

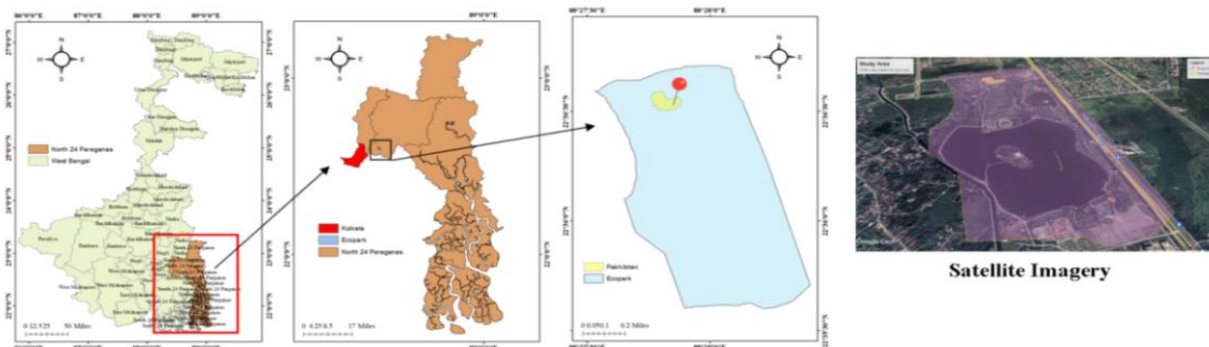


Figure 1: Satellite image of the study area – Pakhhibition, Eco Park in Newtown, Rajarhat Kolkata

2.2. Methods

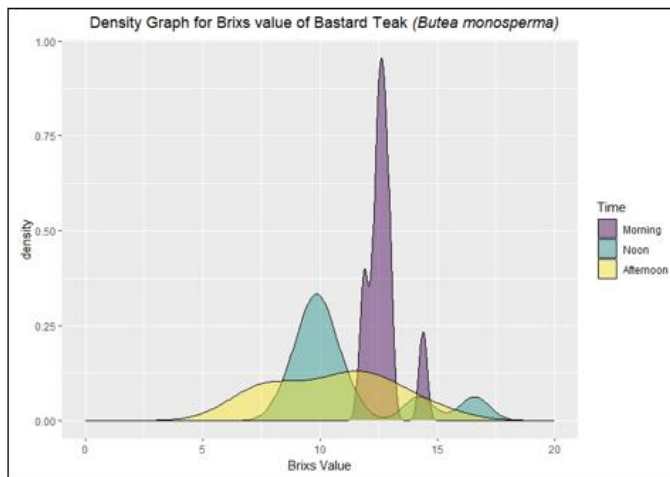
The study was conducted throughout the spring (February – March) of 2024. Flower collection was during the Morning, Noon and Afternoon using random sampling. The total sample effort was 10 flowers per species. For extracting nectar from the flowers, capillary tubes were used, with 30 mm diameter. For measuring nectar concentration, a refractometer (Labert 0-30 % Brix Refractometer ATC High-Concentrated Sugar Solution Content Test Tool) was used, with a range of 0-30% Brix value. Konvio Neer pH paper was used to measure the pH of extracted nectar from different flowers. Nikon Cool Pix B600 camera was used to photograph the flowering plants and their parts. 13 different flower species were collected during their full bloom phase. The nectar was extracted using fine capillary tubes in the first 15 minutes after plucking. The floral species was studied for the nectaries type and positioning [3]. After the extraction of the nectar, a drop of nectar is added to the surface of the refractometer and the strip of pH paper to observe the Brix value and pH value for every species. The Brix value gives 1 degree Brix value (Bx) = 1 g of sucrose / 100g of solution. For statistical analysis, 'R' programming (R core team, 2024) was used.

3. Result

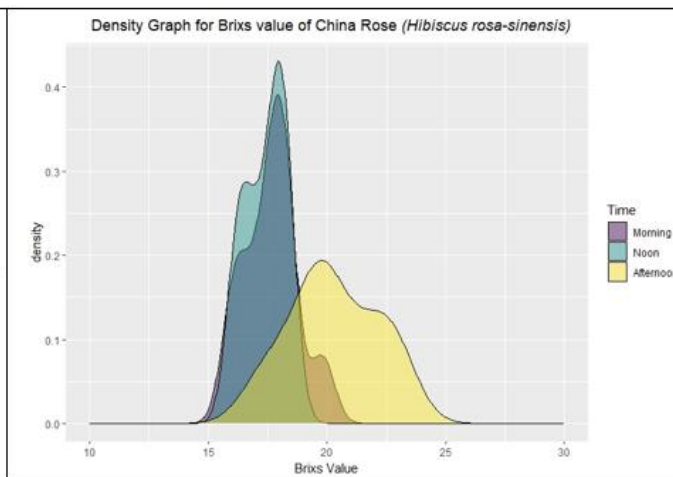
11 different flowers were examined for the nectar concentrations and their variation throughout the day. During the study, random sampling showed significant variation in peak concentration in a particular session. Figure 2 shows that China Rose, Jungle Flame, Bastard Teak and Ashoka showed a more stabilized concentration of 16-23%, 11.6-18.8%, 7.2-16.6%, and 8-14.4%, respectively. Though this range indicates variation, it differs in peak concentration during Morning, Noon and Afternoon. Pink Morning Glory showed a notable concentration between 0-26.2 % in the Brix unit. The peak concentration was observed during the Afternoon. In contrast, Ipomea, Clustered Hiptage (4.2-10.2%) and Common Lantana (20-26.2%) showed a more stabilized graph throughout the day, though also peaking in concentration during the Afternoon. In the case of Powder Puff, Glory Tree, Crown flower and African Tulip, a significant difference in Brix values was observed throughout all three sampling times. The minimum and maximum values differed a lot (Figure 3). The pH level shows that the Glory tree has the lowest pH of 3, and the African Tulip has the highest pH of 9 (Figure 4). Table 1 shows a list of pollinators and visitors of the observed plants. The table indicates the abundant presence of Ants, birds and butterflies as pollinators or just visitors.

Table 1: List of Visitors/Pollinators of observed Plants

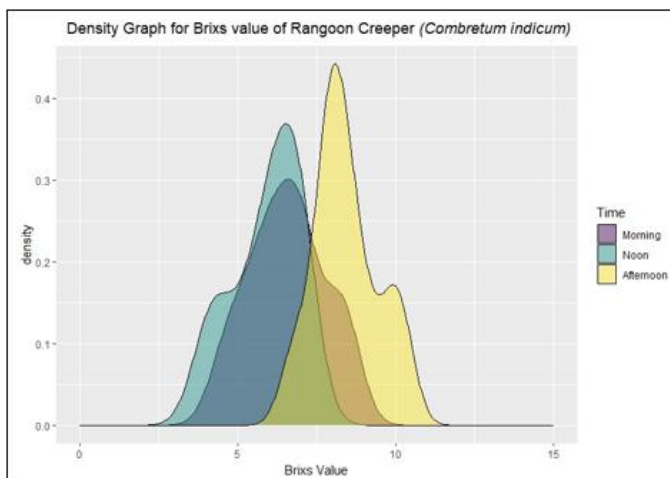
Sl. No.	Name of Plant	Pollinators / Visitors
1.	Bastard Teak ( <i>Butea monosperma</i> )	Birds, Bees, Ants, Squirrel, Butterfly
2.	China Rose ( <i>Hibiscus rosa-sinensis</i> )	Ants, Birds, butterfly
3.	Rangoon Creeper ( <i>Combretum indicum</i> )	Ants, Bees, Butterfly
4.	African Tulip ( <i>Spathodea campanulate</i> )	Birds, Ants
5.	Ashoka ( <i>Saraca asoca</i> )	Bees
6.	Glory Tree ( <i>Clerodendrum infortunatum</i> )	Ants, Butterfly
7.	Jungle Flame ( <i>Ixora coccinea</i> )	Ants, Birds
8.	Crown flower ( <i>Calotropis gigantea</i> )	Ants, birds, Butterfly
9.	Pink Morning Glory ( <i>Ipomea carnea</i> )	Ants, Bees, butterfly, Beetles
10.	Powder puff ( <i>Calliandra haematocephala</i> )	Wasp, birds, Bees, Squirrel, ants
11.	Common Lantana ( <i>Lantana Camara</i> )	Ants, Butterfly, Bees



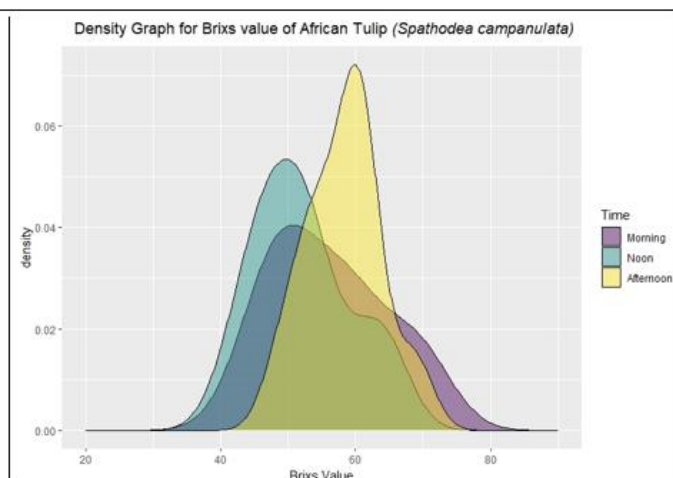
(a)



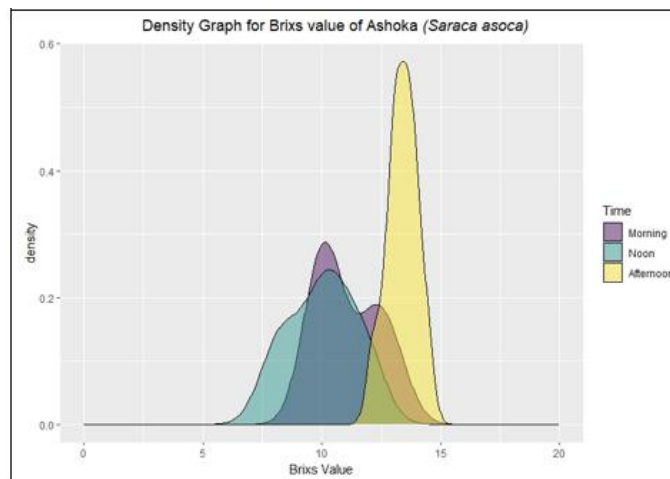
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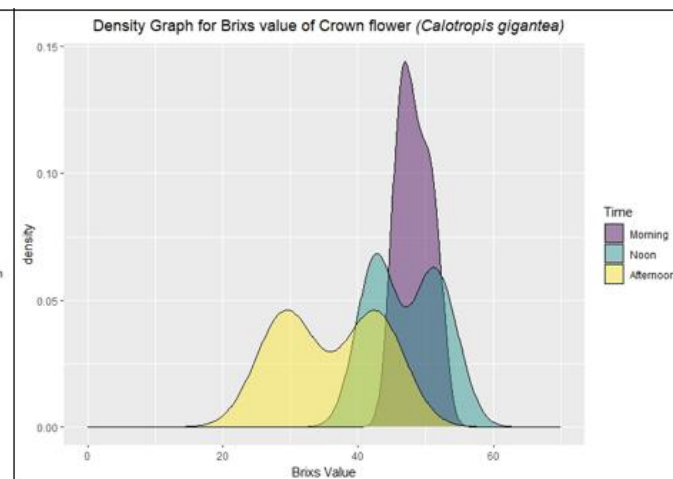
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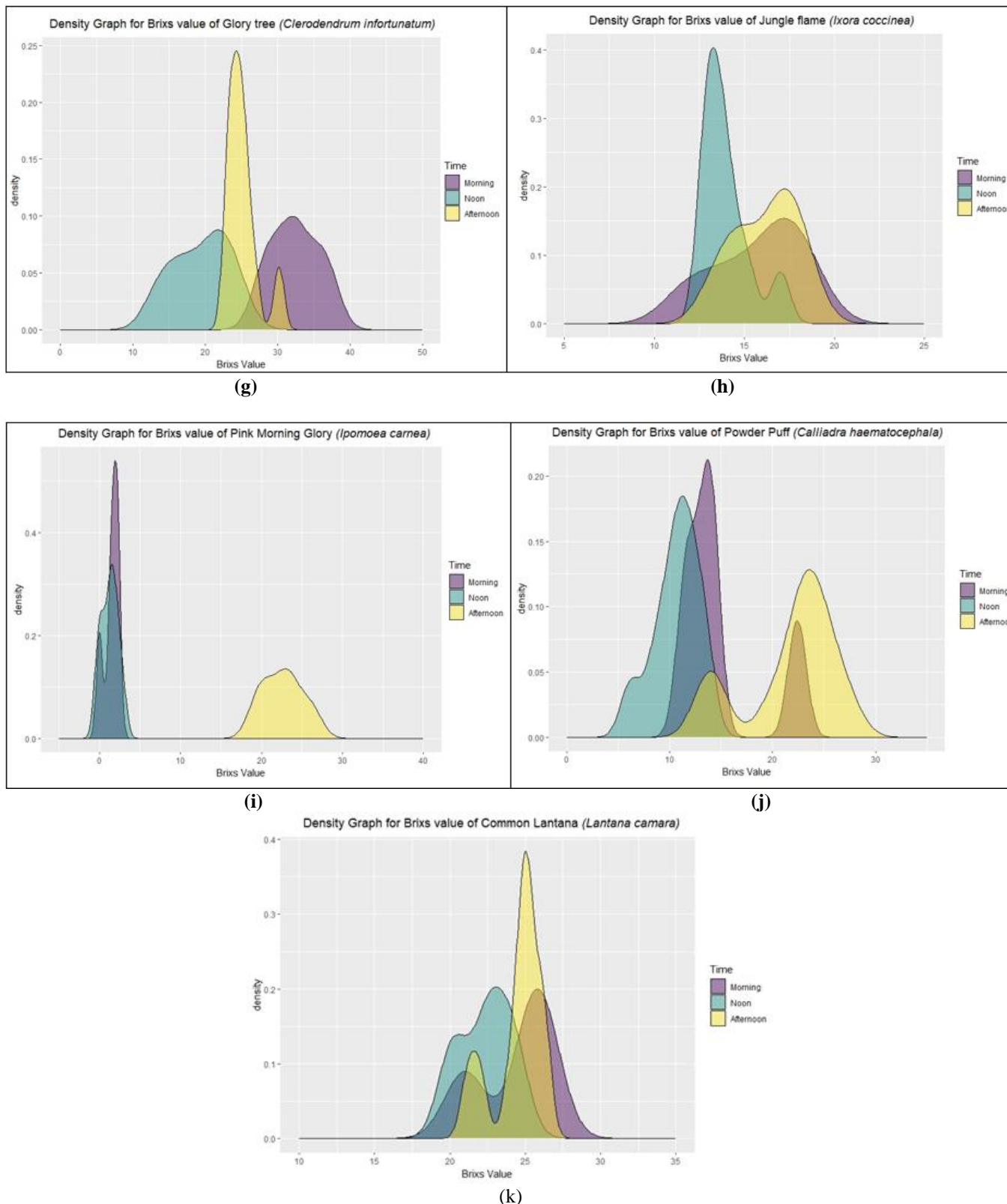
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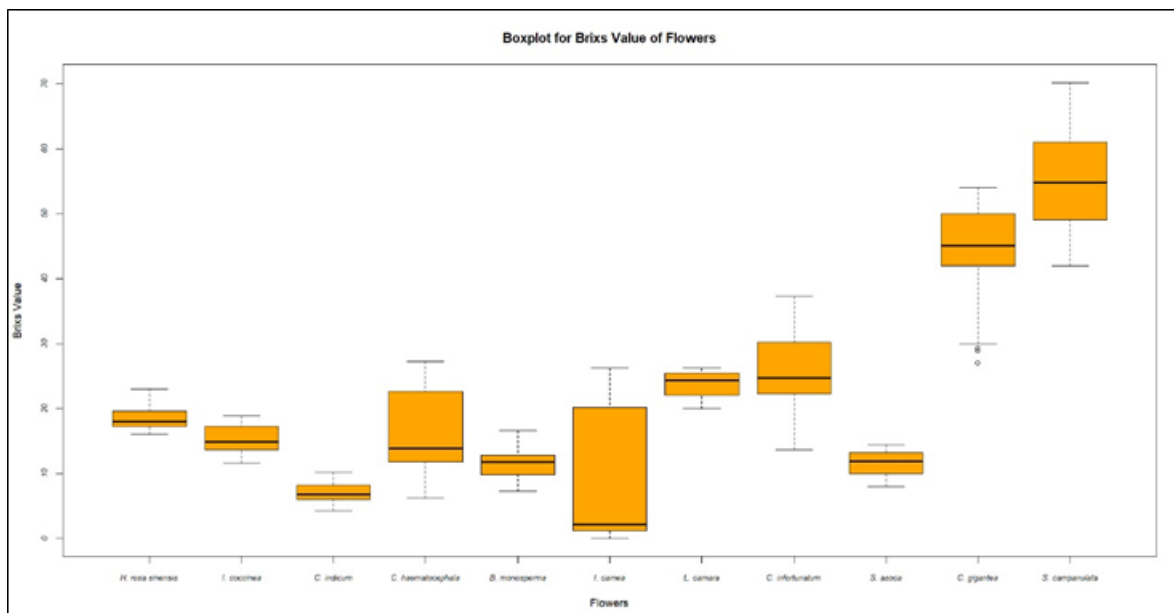
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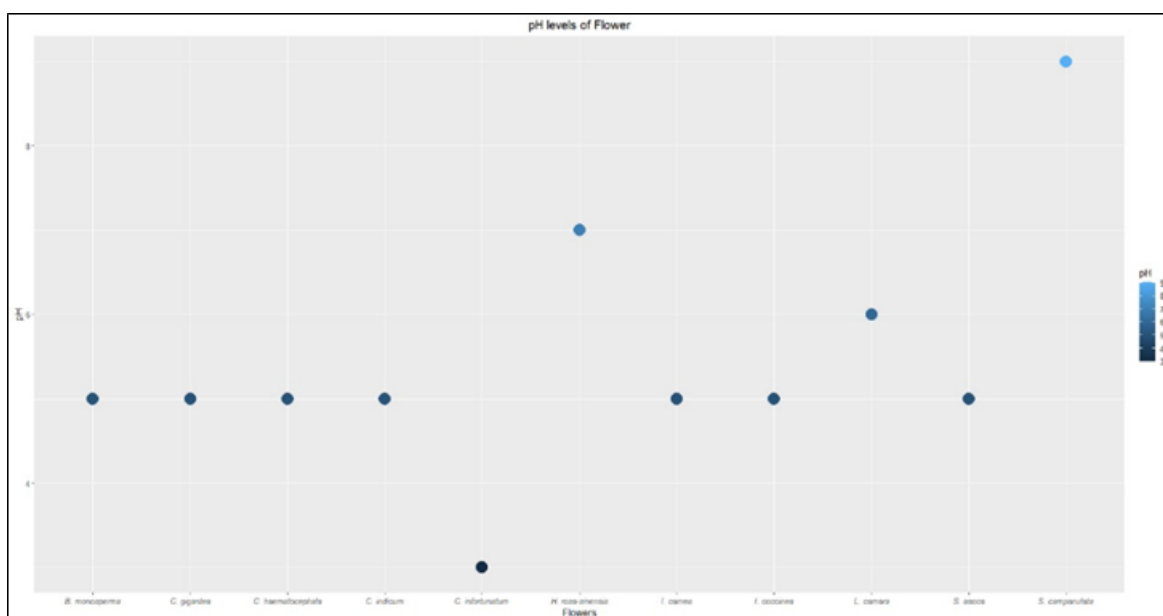
(f)



**Figure 2:** (a) Density graph of Bastard Teak shows a peak in nectar concentration in the Morning session. (b) Density graph of China Rose shows a peak in nectar concentration in the Noon session. The Morning session values are slightly similar to the Noon session values. (c) Density graph of Rangoon Creeper shows a peak in nectar concentration in the Afternoon session. (d) Density graph of African Tulip shows a peak in nectar concentration in the Afternoon session. (e) Density graph of Ashoka shows a peak in nectar concentration in the Afternoon session. (f) Density Graph of Crown Flower shows a peak in nectar concentration in the Morning session. (g) Density graph of Glory Tree shows a peak in Nectar concentration in the Afternoon session. (h) Density graph of Jungle Flame shows a peak in nectar concentration in the Noon session. (i) Density graph of Pink morning glory shows a peak in nectar concentration in the Morning session. (j) Density graph of Powder puff shows a peak in nectar concentration in the Morning session. (k) Density graph of Common Lantana shows a peak in nectar concentration in the Afternoon session.



**Figure 3:** The Box plot of Brix values of different flowers summarizes how the range of Brix value variation within species throughout the day



**Figure 4:** Point graph for pH level of nectar

#### 4. Discussion

The examined nectar concentrations and their variation throughout the day showed significant variations in peak concentration in a particular phase. Among the 11 flower species, some showed significant variation in Brix value throughout the day, whereas some showed a stable concentration. This extreme variation observed in Pink Morning Glory and Powder Puff might be induced by the pollinators. Flowers like China Rose, Rangoon Creeper, Common Lantana, and Ashoka indicate mild changes during all three sessions. While Ipomea, Clusterd Hiptage and Common Lantana reflect a more stabilized concentration throughout the day. This massive difference in the range possibly indicates that the pollination frequency can be high during a particular phase of the day, especially during the Afternoon, reflecting an optimal timing for pollination and nectar collection, thus inducing an increase in nectar

concentration. The floral species-specific temporal variation in nectar concentration may also suggest their different adaptability to pollination strategies and pollinators. Nectar pH was observed based on a 1-14 pH scale. Among all the 11, 5 flowers showed a pH value of 5 on the scale, such as Jungle Flame, Rangoon Creeper, Powder Puff, Crown flower and Ashoka. Bastard Teak and Glory tree showed a more acidic range, having pH 4 and 3, respectively. African Tulips showed a pH value of 9. While flowers like China Rose and Pink Morning Glory showed a neutral pH value of 7. After assessment, most of the nectar pH from the flowers is acidic in nature.

Pollinators are a significant part of a plant's interaction and dynamics with other species of the community to survive as a species. Visitors are not always counted as pollinators, as they often just gain an advantage from collecting nectar but not providing any pollination benefits (Faegri & van der Pijl,

1979) like Nectar robbers collect nectar from flowers without providing any pollen transfer or pollination services for the flowers but nectars sometimes contain distasteful chemicals to deter these nectar robbers. Floral visitors providing proper pollination services are termed 'legitimate pollinators'. Nectar with high sucrose concentration is preferable to legitimate pollinators. Some trees like, Bastard teak and powder puff showed squirrels as frequent visitors of flowers. Mammals being a pollinator for flowering trees was one of the fascinating aspects of our study. The types of visitors depend upon the nectar volume, concentration and pH of flowers. The variety of visitors may also influence the temporal variation in the nectar production of flowers. During the study, some ants were observed as 'nectar robbers' of Bastard Teak and China rose flowers.

## 5. Conclusion

The present study provides a glimpse of the temporal variation of nectar concentration of flowering plants, with

variation in pH. Mild to unstable nectar concentration of flowering plants may reflect adaptation strategies adopted by the flowering plant of Ecopark. Ecopark supports a good diversity of pollinator species, which promises further research in future. The urbanized landscapes with diversified habitats support fauna and flora under specific feeding guilds, providing habitat quality and resource availability. Although with the presence of legitimate pollinators and nectar robbers, the change of nectar concentration according to specific pollinators requires further intensive investigations, especially for species with high conservation interest, and to consider the biotic pollination affinity structure is intact in an urban landscape where the interrelationship of flowering plants and visiting species could ultimately indicate a healthy ecosystem and overall community interactions.



**Figure 5 :** (A) Bastard Teak (*Butea monosperma*), (B) China Rose (*Hibiscus rosa-sinensis*), (C) Rangoon Creeper (*Combretum indicum*), (D) African Tulip (*Spathodea campanulate*), (E) Ashoka (*Saraca asoca*), (F) Crown flower (*Calotropis*)

*gigantea*), (G) Glory Tree (*Clerodendrum infortunatum*), (H) Jungle Flame (*Ixora coccinea*), (I) Pink Morning Glory (*Ipomea carnea*), (J) Powder puff (*Calliandra haematocephala*), (K) Common Lantana (*Lantana Camara*).

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