Collaboratively Inderstanding Education

A Study to Understand the Factors Involved in Regulation of Circadian Rhythm in Drosophila and Phyllanthus

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Introduction

Circadian rhythm is an internal biological clock that regulates the day-to-day activities of organisms over a 24 hour period. The name comes from the Latin phrases "circa" and "diem," which translate to "about a day." All organisms ranging from cyanobacteria to humans sleep wake cycle is controlled by molecular clocks. These molecular pacemakers let organisms better anticipate the rhythmic changes in their environment, which improves fitness(Weaver and Emery, 2013)

Fruit Flies and *Phyllanthus* are best model systems to study sleep wake cycle. Fruit flies are more active during day time and are less active at night. While *Phyllanthus* is a plant which opens its leaves during the day and closes them at night. The aim of our study is to find out the factors involved in regulating sleep-wake cycle of *Drosophila* and *Phyllanthus*.

Objective

- To observe the sleep-wake patterns in *Drosophila* and *Phyllanthus*.
- To find out the role of light and other environmental factors in modifying the sleep-wake cycle of these organisms.

Methodology

Observing activity pattern of *Drosophila* and *Phyllanthus*

Tomato and banana slices were used as a bait to attract fruit flies. Slices were placed on a sheet of paper one near the trash bin and other in gallery near a flower pot. The number of fruit flies visiting the bait at different time intervals i.e after every 2 hours in a day were counted. Likewise, we also took photos of *Phyllanthus*, when leaves started to open to completely open in the morning at one hour intervals. Similarly in the evening took photos till the leaves completely closed. Later correlated activity pattern of fruit flies and *Phyllanthus* with respect to sunrise and sunset time.





The result of normal activity pattern of fruit flies indicated that their sleep wake cycle is not coinciding with sunrise and sunset time. We found fruit flies which are even active at night. Fruit Flies seem to be less active during morning time comparing to evening. It indicates that rather than external time cues there is an internal mechanism is regulating circadian rhythm in fruit flies. The molecular mechanism regulating sleep wake cycle in *Drosophila* indicated that period (per) the timeless (tim) genes involved in regulating circadian rhythm by a negative feedback loop (Liu et al., 1992).



Continuous light experiment

Phyllanthus plants were exposed to continuous light by keeping them under LED light throughout the 24 hours of the day. The time of opening and closing of leaves were recorded, and compared with that of control plants in natural habitat.



In the case of *Phyllanthus*, the leaves started to open before sunrise and started to close before sunset time. In the continuous light experiment. initially, the test showed a delay in time of opening and closing of the leaves compared to the control plants. But after a few days the test plant leaves closed only partially. Yellowing in the leaves was also observed.

The result indicated that even in the continuous light the leaves of *Phyllanthus* continued to open and close its leaves. But there was a delay in the sleep up and wake up time in comparison to control plants.

References point out that, Phyllurin (factor 8) which is the leaf opening factor whose concentration increased during day time result in leaf opening and Phyllanthurinolactone(factor 3) responsible for leaf closing in *Phyllanthus* (Ueda *et a*l., 1999).





The result of normal activity pattern of *Drosophila* and *Phyllanthus* are not coinciding with sunrise and sunset time. We found a few fruit flies which were active even at night. Fruit Flies seemed be to less active during morning time in comparison to the evening period. Our studies suggest that there is an internal clock mechanism that controls the sleep-wake cycle and this variation from the normal activity could be due to mutations in the gene. Our study on *Phyllanthus* suggests that there is an internal mechanism which operates the sleep-wake cycle of these plants, which in turn is regulated by light. These circadian rhythms have evolved to maximise fitness of the organisms.

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Evolutionary perspective of Circadian Rhythm



11:41pm, 21/4/2021

Phyllanthus plant in normal day light condition, 5:26 pm





Are these flies geneti 2nd Bottle

CUBE chatShaala: 30th Jan 2023

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Day Actives

> Is there a possibility of adaptation and natural selection?

Phyllanthus plants under street light, 9pm

Conclusion and Future Work

We plan to further

• Study the process of leaf opening and closing in *Phyllanthus* plants, and find out the advantage the process confers on the plant.

• Search for populations of fruit flies and *Phyllanthus* plants showing aberrant circadian rhythms and study them.