

ABSTRACT

Thesis title: The effect of light on anthocyanin accumulation, antioxidant capacity, and DNA methylation.

Author name: Kosanam Jerusha (A2DKPF)

Institute: Institute of Genetics and Biotechnology

Insider subject leader: Zsófia Kovács, Senior Lecturer, institute of genetics and biotechnology

This study examines the effect of light on anthocyanin accumulation, antioxidant capacity, and how DNA methylation affects the anthocyanin biosynthesis in *Capsicum annuum*. Anthocyanins are secondary metabolites and water-soluble flavonoids responsible for red, blue, and purple pigmentation. Anthocyanins protect the cells from oxidative stress during environmental stresses by neutralizing reactive oxygen species (ROS). The research compared covered and illuminated flowers of the same genotype to eliminate genetic variation and decide the specific role of light exposure. Analytical assays like Total Polyphenolic Content (TPC), Ferric Reducing Antioxidant Power (FRAP), and Total Flavonoid Content (TFC) were performed to evaluate phenolic concentration and antioxidant capacity under different light conditions. Further, methylation pattern was also evaluated of covered and illuminated flowers. To test the effectiveness of anthocyanins produced by the plant against *Fusarium culmorum* a detached leaf assay was carried out with the same genotype. In the purple pepper flowers anthocyanins are dominant phenolic compound from that anthocyanins are estimated along with all the flavonoids.

Results showed that illuminated flowers exhibited significantly higher TPC, FRAP, and TFC values, confirming that light exposure enhances phenolic synthesis and antioxidant potential. Methylation-sensitive amplified polymorphism (MSAP) revealed that DNA methylation was lower in uncovered flower samples, particularly at CCGG sites, this indicates that demethylation under light conditions activates anthocyanin biosynthetic genes. In addition, detached leaf assays practically exhibited that purple anthocyanin-rich leaves had lower levels of reactive oxygen species (ROS) and exhibited greater resistance to *Fusarium*

culmorum infection compared to the green leaves, emphasize anthocyanin's protective function.

In conclusion, light acts as a critical environmental factor regulating anthocyanin biosynthesis in *Capsicum annuum* by reducing DNA methylation and promoting gene expression. The increased anthocyanin content enhances antioxidant defense and pathogen resistance, reinforcing the pigment's dual role in photoprotection and plant health. this study also emphasizes the health benefits for humans in consuming anthocyanin rich food.