Systematic Review: UV Radiation and Its Impact on Living Organisms

Proposed by *UPRI : ERIT PSII - Plant Science, Interactions and innovation*

Abstract

The interaction between ultraviolet (UV) radiation and living organisms is a critical area of study. This systematic review aims to comprehensively analyze the effects of UV radiation on various organisms, spanning from microbes to plants and animals. By examining existing research, we explore the consequences of UV exposure on health, ecology, and ecosystem dynamics. Our findings contribute to a deeper understanding of UV-related risks and inform strategies for mitigating its impact.

Introduction

UV (ultraviolet radiation) is a broad spectrum of light encompassing UV-A (315-400 nm), UV-B (280-315 nm), and UV-C (100-280 nm) wavelengths. While UVA and UVB penetrate the Earth's atmosphere, UV-A radiation (95%) and, to a lesser extent, UV-B (5%) (Correa et al., 2023), UV-C is largely filtered out, reaching us only in minimal amounts. The ozone layer efficiently filters UV-C radiation, but UV-B penetrates deeper into the Earth's surface due to ozone depletion. UVR has been shown similar impacts on different species. These UV impacts are DNA damage and repair mechanisms, protein unintegration and destabilization, cellular and physiological functions and cause long-term effects on health and adaptation in all living organisms. While valuable for disinfection by its germicidal properties, it can also cause detrimental effects on living organisms, including plants, animals and humans. In human and animals, it causes health disorders, immunity disruption, cancer, skin lesions, optic tumors, caloric stress or even death (Londero et al., 2019; Neale et al., 2023). In plants similar hazards and damages are caused by UV exposure.

1. **Background**: Briefly introduce the significance of UV radiation in the natural environment. Discuss its sources (solar radiation, artificial UV sources), wavelengths (UVA, UVB, UVC), and potential effects on living organisms.
2. **Research Question**: Formulate the central research question: "How does UV radiation impact different organisms across diverse ecosystems?"

Methods

1. **Search Strategy**:
    - Define inclusion and exclusion criteria.
    - Conduct a comprehensive literature search across databases (PubMed, Web of Science, Scopus, etc.) using relevant keywords (e.g., "UV radiation," "organism," "ecosystem," "health effects").
    - Retrieve relevant studies, reviews, and meta-analyses.
2. **Study Selection**:
    - Screen articles based on title, abstract, and full text.
    - Include studies that investigate UV exposure in various organisms (microbes, plants, animals).
3. **Data Extraction**:
    - Extract relevant data from selected studies (e.g., study design, sample size, UV exposure levels, outcomes).

    - Categorize organisms based on taxonomic groups.
4. **Quality Assessment**:
    - Evaluate the quality of included studies using appropriate tools (e.g., Newcastle-Ottawa Scale, Cochrane Risk of Bias Tool).
5. **Data Synthesis**:
    - Summarize findings across studies.
    - Identify patterns, trends, and knowledge gaps.

Results

1. **Effects on Microbes**:
    - Discuss UV impact on bacteria, archaea, and viruses.
    - Explore mechanisms (e.g., DNA damage, repair mechanisms).
2. **Effects on Plants**:
    - Address UV effects on photosynthesis, growth, and reproductive success.
    - Consider adaptations (e.g., UV-absorbing pigments, protective structures).
3. **Effects on Animals**:
    - Investigate UV impact on various taxa (insects, amphibians, reptiles, birds, mammals).
    - Highlight behavioral changes, immune responses, and reproductive outcomes.

Discussion

1. **Ecological Implications**:
    - Discuss ecosystem-level consequences of UV exposure.
    - Consider trophic interactions, food webs, and community dynamics.
2. **Human Health Implications**:
    - Explore UV-related health risks (e.g., skin cancer, cataracts).
    - Address protective measures (e.g., sunscreen, clothing).
3. **Conservation Strategies**:
    - Propose strategies to mitigate UV effects on biodiversity.
    - Advocate for ozone layer protection (Montreal Protocol).

Conclusion

Summarize key findings and emphasize the need for interdisciplinary research to address UV-related challenges. Highlight the role of UV radiation in shaping ecosystems and influencing the health of living organisms.

This systematic review provides a comprehensive overview of UV radiation's impact on diverse organisms, fostering awareness and informing future research and conservation efforts.