

Effect of Sunlight on Growth and Melanin Pigment Production in Bacteria and Fungi

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ABSTRACT: Radiation from the Sun, which is more popularly known as sunlight, is a mixture of electromagnetic waves ranging from infrared (IR) to ultraviolet rays (UV). It also includes visible light, which is in between IR and UV in the electromagnetic spectrum. Ultraviolet (UV) radiation is the part of sunlight which causes sunburn, skin tanning, skin damage and skin cancer. In high intensity of sunlight, more quantity of melanin production is induced due to stimulation of melanocytes of skin. Same effect was observed in case of bacteria as well as fungi. In the present investigation, isolates namely *Pseudomonas guezenei*, *Clostridium tertium*, *Kocuria flava*, *Aspergillus niger*, *Aspergillus fumigatus* and *Botryosphaeria rhodina* were able to grow as well as produce melanin when incubated under sunlight for one week.

KEYWORDS: melanin production, effect of sunlight, bacterial melanin, fungal melanin.

I. INTRODUCTION

Melanin is the main pigment responsible for the various pigmentations found in animal and human skin, hair, and eyes (F.Solano, 2014). We get exposed to sunlight and ultraviolet radiations all the time and melanin pigment protects us from the harmful effects of these radiations. Once ultraviolet rays penetrate the skin, they work directly on cells called melanocytes. Melanocytes are responsible for producing melanin, the substance in our body that gives the skin its coloring. The ultraviolet rays work as a catalyst for the increased production of melanin. The more time spent exposed to ultraviolet rays, the more melanin will be released. The greater amount of melanin released, the darker the tan will become. This same ability to produce melanin and protect is widespread among microorganisms too. Melanin is produced by algae, fungi, bacteria, actinomycetes, etc. From the chemical point of view, the only common feature of microorganismal melanins is being a product of oxidative polymerization of various phenolic substances, thus melanins form a quite heterogenous group of biopolymers (Sajjan *et al.*, 2010) As a consequence, melanogenesis can serve as an example for evolutionary convergence – the final product can be achieved on various metabolic pathways, even in one taxon. As mutations in genes determining melanin production are rarely lethal, at least under *in vitro* conditions, this feature seems not to be indispensable for life, although it creates a powerful adaptative advantage. The possible scenario of evolution might include, first, extracellular autooxidation of some phenolic compounds and amino acids due to the appearance of oxygen in the atmosphere, to improve the environmental conditions, active secretion of the substrates of melanogenesis and of enzymes supporting this process followed by a gradual adaptation to the intracellular control of the process to export or storage of the product. In parallel, 'secondary' biological functions of melanins might have developed. Melanin pigments are composed of many different units, and these units are connected through strong carbon-carbon bonds, which makes the systematic characterization of melanin very difficult (Shosuke Ito, 2003).

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II. RELATED WORK

In 2007, Dadachova E. *et al.* had published that some types of fungi, which are called as radiotrophic fungi, appear to be able to use melanin as a photosynthetic pigment that enable them to capture gamma rays and harness this energy for growth. There was no other related work found in the literature survey.

III. MATERIAL AND METHODS

Nutrient agar media, potato dextrose agar media and L-tyrosine were purchased from HiMedia chemicals, Mumbai, India. Ultrapure water was used for the experiments and aseptic conditions were maintained wherever necessary.

A qualitative study was done to see the effect of sunlight on the growth and pigment production of the selected six bacterial as well as six fungal isolates. The experiment was performed in the Department of Microbiology, Shri Shivaji college, Akola, Maharashtra, India (geographical location - 20.720403N 77.001316W). This study was done in the month of March when temperature was between 42-45°C. In this study, nutrient agar media and potato dextrose agar media enriched with the amino acid L-tyrosine were prepared, autoclaved and inoculated with the bacterial as well as fungal pure cultures on respective media [*Pseudomonas guezenei* - accession number (KX648432); *Clostridium tertium* - accession number (KX648433); *Kocuria flava* - accession number (KX648434); *Aspergillus niger*; *Aspergillus fumigatus* and *Botryosphaeria rhodina*] which were then incubated outdoor in sunlight by placing in a glass chamber with its lid half open for 7 days (1week). The growth and pigment production was observed daily. (The accession numbers are provided by GenBank).

IV. EXPERIMENTAL RESULTS

The effect of sunlight experiment showed that isolates namely *Pseudomonas guezenei*, *Clostridium tertium*, *Kocuria flava*, *Aspergillus niger*, *Aspergillus fumigatus* and *Botryosphaeria rhodina* were able to grow as well as produce melanin when incubated under sunlight. The fungal isolates, *Aspergillus fumigatus* and *Botryosphaeria rhodina*, showed growth and pigment production within 48 hours of incubation while *Aspergillus niger* took 72 hours to show the results. Among the bacterial isolates, *Kocuria flava* showed growth and melanin pigment production within 24 hours of incubation under sunlight while *Pseudomonas guezenei* and *Clostridium tertium* strains required 48 hours to show the results. The growth and melanin pigment production was found directly proportional to each other. The results are presented photographically.

Figures shows the results of effect of sunlight on different bacteria as well as fungi. Fig. 1 shows the image of effect of sunlight on bacterial isolates *Pseudomonas guezenei*, *Clostridium tertium* and *Kocuria flava*. Fig. 2 (a), (b) and (c) shows images of effect of sunlight on fungal isolates *Aspergillus niger*, *Aspergillus fumigatus* and *Botryosphaeria rhodina* respectively.

Fig. 1 shows the image of effect of sunlight on bacterial isolates *Pseudomonas guezenei* (dark brown), *Clostridium tertium* (light brown) and *Kocuria flava*.(faint yellow)



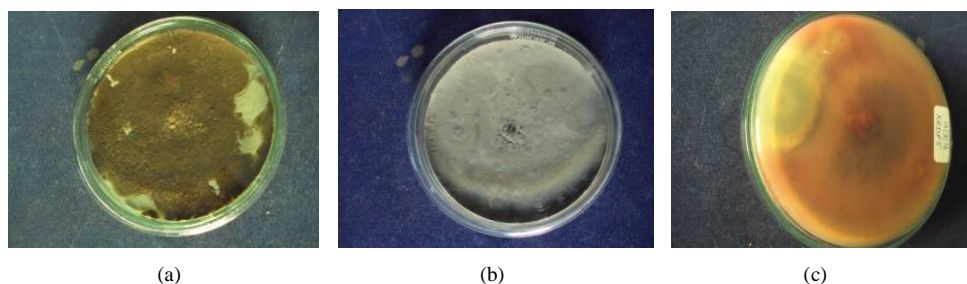
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Fig. 2 (a), (b) and (c) shows images of effect of sunlight on fungal isolates *Aspergillus niger*, *Aspergillus fumigatus* and *Botryosphaeria rhodina* respectively.



V. CONCLUSION

From the above study, it was concluded that the bacterial isolates namely *Pseudomonas guezzennei*, *Clostridium tertium* and *Kocuria flava* while fungal isolates namely *Aspergillus niger*, *Aspergillus fumigatus* and *Botryosphaeria rhodina* could tolerate and absorb sunrays which proves the melanin pigment's ability to protect an organism in harsh conditions and they can maintain their species in nature.

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