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Development of Antimicrobial Fabric using Microbial Pigment Found in Mangrove Soil of Saravali, Boisar, M.S India

Hardik S. Churi[1] and Shivali K. Shukla[2]

[1,2]Department of Biotechnology, S.D. Arts, V.S.Apte Commerce, M.H.Mehta Science College, Palghar 401 404, M.S., India

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ABSTRACT

Mangrove is a tropical plant that protects the coastlines from storms and erosion. The halophilic environment of mangroves contains numerous microbes which produce unique compounds like pigments. Synthetic pigments are harmful to both humans and the environment. Synthetic pigments can be replaced by natural pigments which are easily available and have no harmful effects on human beings and the environment. The production of such pigment is inexpensive. The focus of this project is to develop an antimicrobial fabric by using microbial pigment. Yellow and orange pigment-producing microbes were isolated from mangrove soil. The characterization of pigment was done and used to dye the fabric whose antimicrobial activity was studied against *Escherichia coli* and *Staphylococcus aureus*.

Key words: *Mangrove soil, Pigment, Fabric dyeing, Antimicrobial fabric.*

Introduction

Pigments play an essential role in human life and are widely used for various purposes by numerous industries like cosmetics, food, pharmaceuticals, and fabrics. The drastic growth in industries and the human population increases the demand for pigment. Synthetic pigments are xenobiotics and hazardous to the environment. Traditionally pigments were extracted from plants but the process was time-consuming (Saha *et al*., 2017). To overcome this problem, researchers are focusing on the bulk production of microbial pigment.

Mangrove forests are unique functional ecosystems having much social, economic, and biological importance. Mangroves provide a unique ecological niche to different microbes which play various roles in nutrient recycling as well as various environmental activities (Pillai *et al.,* 2018). The halophilic environment of mangrove soil allows the growth of microbes that produce various bioactive compounds like pigments that possess properties such as antioxidants, anticancer, and antimicrobials.

The Palghar-Boisar region offers an extensive pool of untapped resources, including mangroves, mudflats, coral reefs, seaweeds, lagoons, and estuaries for the production of bioactive substances. Regrettably, exploring biological diversity in these zones has received little attention. However, this region is marred by various industries that persistently pollute the environment. Hence, there is a need for more research to unveil the hidden treasures of this area and pave the way for the sustainable exploration of its resources.

([1]Assistant Professor, [2]Research Scholar)

Materials and Methods

The Saravali region of the Palghar district is an industrial area that generates lots of pollutants. The soil sample was collected by scoop method from mangrove trees (Churi and Palan 2020). The soil sample was spread on a nutrient agar plate and incubated at room temperature for 48hrs. The well-isolated pigment-producing colonies were studied for morphological and cultural characteristics. The biochemical characteristics along with gram staining were performed for basic identification. The maximum pigment production was determined by using variations in two parameters like temperature (4 °C, 28 °C, 37 °C, and 55 °C) and pH (2, 4, 7, 9, and 11). Different solvents like water, methanol, acetone, and chloroform did the partial purification of pigment. The 2,4 Di-nitro-phenyl hydrazine (DPPH) was used to determine the antioxidant activity of extracted pigment. Fabric discs of 1 cm diameter were dyed using an extracted pigment with the help of a mordant ($FeSO_4$). The disc diffusion method was used to check the antimicrobial activity of dyed fabric against *Staphylococcus aureus* and *Escherichia coli*.

Result and Discussion

Among the 35 colonies obtained from the soil sample, the yellow pigment-producing colony dominated over the others. The yellow pigment was isolated on nutrient agar (Fig. 1). Malik *et al.,* 2014, found 20 bacterial isolates out of which ten showed pigment production. Rameshkumar *et al.,* 2009, reported several pigment-producing microbes from the mangrove microbial community. The gram-negative rods were observed after gram staining of the yellow pigment colony. Noor *et al.*, 2018, found that most of the pigment-producing bacteria were gram-negative with bacillus or rod shape.

Yellow pigment-producing microbes show positive results in the sugar fermentation test, catalase test, and coagulase test. Malik *et al.,* 2014, observed the positive result in Methyl Red, Catalase, and Nitrate Reductase tests. The pigment-producing microbes were incubated at 37°C and maximum pigment production was observed at pH 7. Choubey *et. al.,* (2021) recorded the maximum pigment-producing activity at pH 7. The pigment was extracted using different solvents that methanol was found to be the best solvent. The DPPH assay was used to check the antioxidant activity of the pigment. The absorbance was determined colorimetrically at 520 nm. The percent scavenging activity by DPPH assay of isolated pigment was found to be 21.73%. Churi H. and Palan S. (2020) found the percentage scavenging activity of yellow pigment was 33.33%. The $FeSO_4$ was used as a mordant for the dyeing of fabric and after the process yellow color was obtained on the fabric. The yellow pigment showed a zone of inhibition against *S. aureus* and *E. coli* having a diameter of 2.0 cm and 1.8cm respectively.

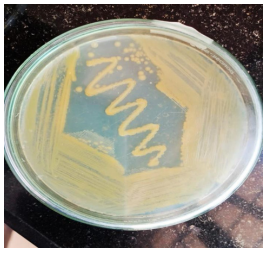

Fig. 1. Yellow pigment-producing bacteria on Nutrient agar

Conclusion

The study demonstrates the presence of pigment-producing bacteria in Boisar's Saravali region's mangrove soil. A basic comparison between the yellow pigment-producing colony and Bergey's manual revealed that the organism was Bacillus sps. The DPPH assay revealed that the percentage of scavenging activity was 21.37 percent, with the maximum pigment production occurring at pH 7. The discs of fabric were dyed yellow with pigment. The zone of inhibition against *Staphylococcus aureus* and *Escherichia coli* was measured using the disc diffusion method and found to be 2.0 cm and 1.8 cm respectively. According to the findings of the research, the naturally pigmented fabric's antioxidant and antimicrobial properties make it suitable for further medical applications.

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