BIODEGRADATION OF BP-3 USING GRAM-NEGATIVE BACTERIAL STRAINS

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Abstract

Organic UV filters are common compounds in the aquatic environment. These chemicals are used as active substances in chemical formulations of personal care products, in order to protect the skin, lips and hair against solar UV radiation. Organic UV filters easily reach the aquatic environment by incompletely removal in wastewater treatment plants and subsequent discharge of effluents into surface waters. These substances pose a threat to aquatic organisms because many of them exhibit hormonal activity. Benzophenone-3 (BP-3) is the most commonly used UV filter in cosmetic formulations worldwide. In surface waters in Romania, the concentration range detected for BP-3 ranged between 3-52 ng/L. Thus, degradation using bacterial strains can be a promising alternative to reduce the problems of environmental pollution with BP-3. Bacteria are a cost-effective alternative to catalytic processes. Finding suitable bacterial strains for BP-3 removal could improve the WWTP process by bioaugmentation. The aim of this study was the biodegradation of BP-3 in presence of two bacterial strains, namely Salmonella typhymurium and Serratia rubidae.

Materials and methods

1. Seeding gram-negative bacterial strains on solid nutrient medium
2. Incubation of each colony in liquid medium
3. Spectrophotometric determination of bacterial growth at 600 nm
4. Incubation of bacterial strain with BP-3 for 24h
5. Sample preparation by acetonitrile deproteinization
6. LC-MS/MS analysis

Results

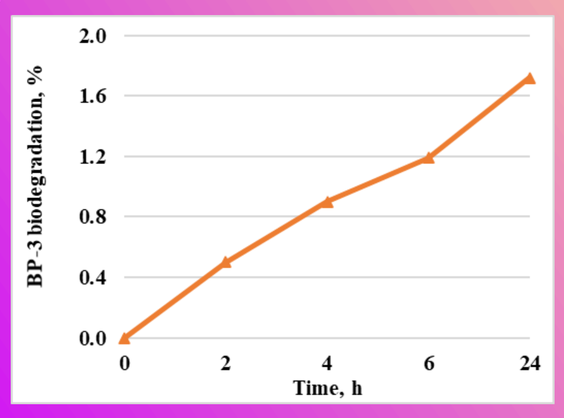
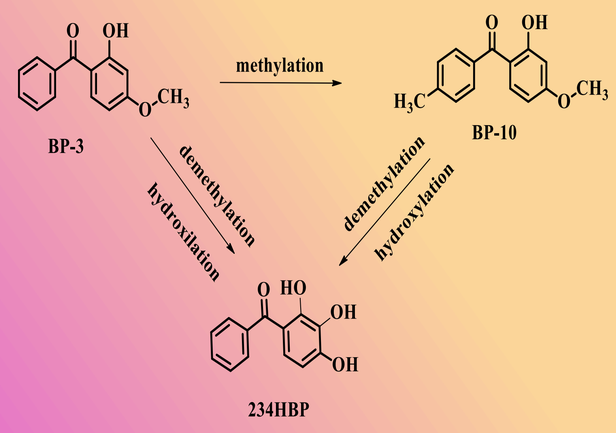
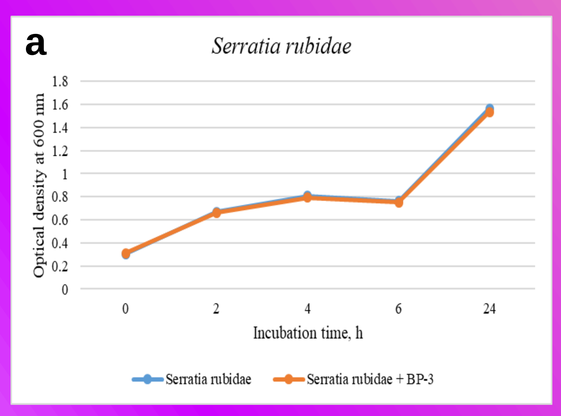


Figure 1. BP-3 evolution at different concentrations over time in the presence of *Serratia rubidae*



Scheme 1. The proposed mechanism for biodegradation of BP-3 by *Serratia rubidae*



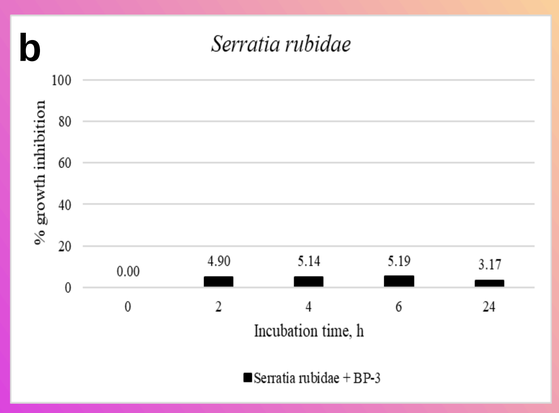


Figure 2. Optical density at 600 nm of Serratia rubidae in presence or absence of BP-3 (a) and growth inhibition (%) in presence of BP-3 (b)

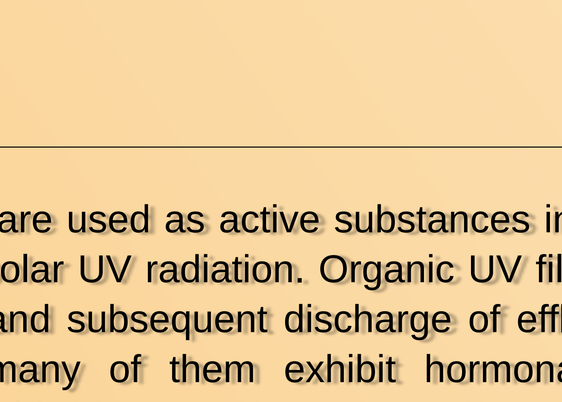
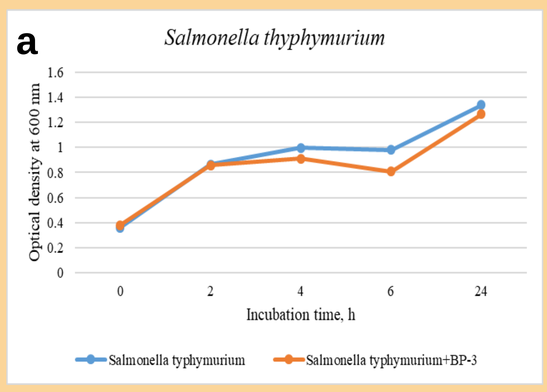


Figure 3. BP-3 evolution at different concentrations over time in the presence of *Salmonella typhymurium*



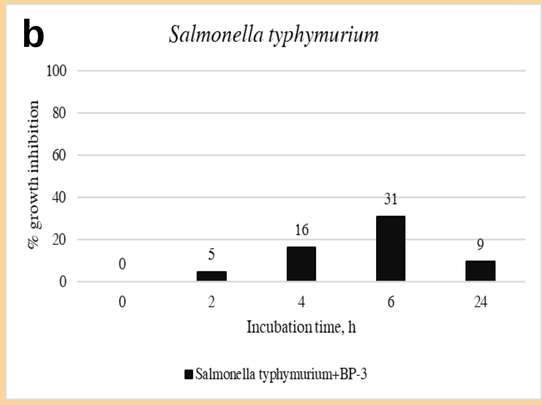
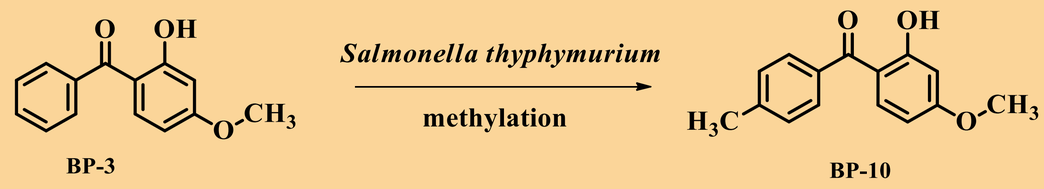


Figure 4. Optical density at 600 nm of Salmonella typhymurium in presence or absence of BP-3 (a) and growth inhibition (%) in presence of BP-3 (b)



Scheme 2. The proposed mechanism for biodegradation of BP-3 by Salmonella typhymurium

Conclusions

This study is, to our knowledge, the first to show that gram-negative bacterial strains such as *Salmonella Typhymurium* and *Serratia rubidae* may have the ability to biodegrade BP-3. Although the UV filter has been degraded to a relatively small percentage of only 2%, changing working conditions (BP-3 concentration, increasing incubation time) can contribute to increasing the percentage of BP-3 biodegradation.

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