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INVESTIGATION ON BIO-DEGRADATION OF XENOBIOTICS: A REVIEW

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Abstract

One of the major environmental problems today is the accumulation of recalcitrant xenobiotics in the ecosphere. They are relatively stable and persist in the environment for several decades. Many methods such as physico-chemical and biological methods have been employed in the degradation of xenobiotics. Since physico-chemical methods are expensive, biological methods employing microorganisms are widely used. Several practices have been implemented for degrading these recalcitrant, bioremediation step is proved to show the significant impact on them. Giving a brief note on types of xenobionts and their impact on the environment, this study attempts to highlight on different xenobiotic degradation methods like bacterial bioremediation, phycoremediation, phytoremediation .The present review gives a brief discussion on the role of microorganisms in degradation of xenobiotics – petroleum hydrocarbons and pesticides.

Keywords : *Xenobiotic degradation, petroleum hydrocarbons, pesticides, microorganisms, microbial, phycoremedation, phytoremedation*

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1. INTRODUCTION

1.1 What is mean by Xenobiotics?

The term xenobiotic (Greek xenos + bioticos, which means “strange” and “life-related” respectively) means a chemical substance that is not a natural component of a living organism exposed to it, i.e. a strange, exogenous substance or anthropogenic material. This definition covers substances strange to the target organisms, hence its use for most poisons and drugs (1). Xenobiotic compounds are relatively persisting in the environment because they are highly thermodynamically stable. The main concern with xenobiotic compounds is the toxicity threat they pose to public health. Xenobiotic compounds can have various toxic effects on humans such as exhibit acute carcinogenic, mutagenic, teratogenic effects, etc. The overall damage in ecosystem caused by xenobiotic compounds has motivated researchers to develop new strategies for their removal from the contaminated environment (2).

1.2 Sources of Xenobiotics

Direct sources:

The prime direct source of xenobiotics is wastewater and solid residual releases from the industries like chemical and pharma, plastics, paper and pulp mills, textile mills, agricultural (enhancement products like pesticides, herbicides etc.) (Figure 1). Some of the common residual compounds in the wastewater and other effluents are Phenol, hydrocarbons, different dyes, paint effluents, Pesticides and Insecticides etc (3).

Indirect sources:

Indirect sources of xenobiotics include NSAIDs, pharmaceutical compounds, pesticide residues etc

Non Steroidal Anti-inflammatory Drugs (NSAIDs) are a large diverse chemical group of drugs used in humans and animals for the treatment of inflammation, pain and fever (analgesic). Diclofenac use in animals has been reported to have led to a

sharp decline in the vulture population, 95% decline in 2003, 99.9% decline as of 2008(3)

2. XENOBIOTIC DEGRADATION

Several methods like physico-chemical and biological methods have been employed in the treatment or removal of xenobiotics. The physico-chemical methods are costly and often produce undesirable products which are toxic, requiring further treatment steps . Such type of techniques often add fragmented elements which cannot be degraded easily and will make the environment still worse. To overcome these problems, many other eco-friendly techniques have been reported such as Bioremediation, phytoremediation etc (4).

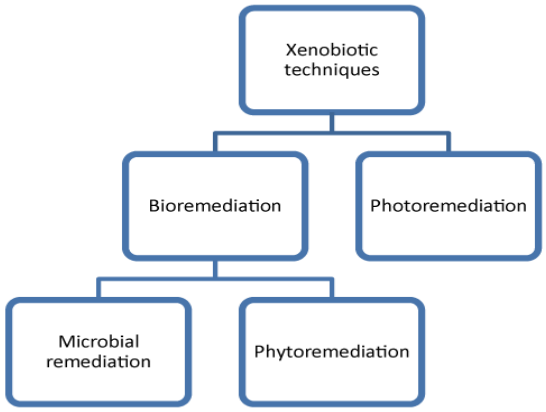

Fig-1: Structure of Bio Degradation Process

3. MICROBIAL DEGRADATION OF XENOBIOTICS

Microorganisms play a major role in degradation of xenobiotics. They transform toxic contaminants in to non-hazardous or less hazardous substances. Most of the micro-organisms, particularly bacteria are known for detoxifying abilities.[5] They mineralize, transform or immobilize the pollutants. Examples of aerobic and anaerobic xenobiotics degradative bacteria are Pseudomonas, GordoniaA, Bacillus, Moraxella, Micrococcus, Escherichia, Sphingobium, Pandoraea, Rhodococcus, and anaerobic xenobiotics degradative bacteria are Pelatomaculum, Desulphovibrio, Methanospirillum, Methanosaeta desulfotomaculum, Syntrophobacter, Syntrophus. Among them, Pseudomonas species and Bacillus species have been the most widely studied. Many other bacterial species which assist in degradation of recalcitrant xenobiotic compounds (6).

3.1. Phycoremediation

Phycoremediation applied to the removal of nutrients from animal wastewater and other high organic content wastewater is a field with a great potential and demand considering that surface and underground water bodies in several regions of the world are suffering of eutrophication This efficiency.include Algae growth rate controls directly and indirectly the nitrogen and phosphorus removal The use of filamentous microalgae with a high autoflocculation capacity and the use of immobilized cells have been investigated in this respect. Another key area of research is the use of algae strains with special attributes such as tolerance to extreme temperature, chemical composition with predominance of high added value products, a quick sedimentation behavior, or a capacity for growing mixotrophically(7).

3.2 Phytoremediation

Phytoremediation is a cost-effective plant-based approach of remediation that takes advantage of the ability of plants to concentrate elements and compounds from the environment and to metabolize various molecules in their tissues. It refers to the natural ability of certain plants called hyperaccumulators to bioaccumulate, degrade, or render harmless contaminants in soils, water, or air. Toxic heavy metals and organic pollutants are the major targets for phytoremediation. Knowledge of the physiological and molecular mechanisms of phytoremediation began to emerge in recent years together with biological and engineering strategies designed to optimize and improve phytoremediation

4. CONCLUSION

Environmental problems caused by the industrial effluents is mainly due to accumulation of pollutants and other fragmented compounds, which in turn form into other substitutes (natural or manmade), finally forming a xenobiont. There is a quick need to degrade these xenobiotic compounds in an eco-friendly way. Various techniques like microbial remediation, phytoremediation and photoremediation and their subtypes have been discussed. Each having their own ways of degrading these xenobionts, also have negative impact on the environ (side effects due to fragmentations and bioaccumulations we also have studied about sources of xenobioant (7).

REFERENCES

[1]. http://www.ietu.katowice.pl/wpr/Slownik_terminow.htm 10.04.2008.

[2]. Sinha, S., Chattopadhyay, P., Pan, I., Chatterjee, S., Chanda, P., Bandyopadhyay, D., Das, K. and Sen, S.K. (2009). Microbial transformation of xenobiotics for environmental bioremediation. African Journal of Biotechnology; 8(22): 6016–6027.

[3]. Nikki Agarwal and Sushil Kumar Shahi. (2015). An Environmental cleanup strategy – Microbial transformation of Xenobioti compounds. International Journal of Current Microbiology and Applied Sciences; 4(4): 429–461.

[4]. Varsha, Y.M., Naga, Deepthi, C.H., and Chenna, S. (2011). An emphasis on xenobiotic degradation in environmental cleanup. Journal of Bioremediation and Biodegradation; 11: 1–10.

[5]. Janssen, D.B., Dinkla, I.J.T., Poelarends, G.J. and Terpstra, P. (2005). Bacterial degradation of xenobiotic compounds: evolution and distribution of novel enzyme activities. Environ. Microbiol; 7: 1868–1882.

[6]. Microbial dehalogenation. Current Opinion in Biotechnology 2001, 12, 254.

[7]. http://www.sciencedirect.com/science/article/pii/S0734975003001307