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Use of Environmental Biotechnology to Reduce Environmental Pollutions

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Abstract

Environmental pollution is a major problem in the present era. Every time, we are consuming toxicants with our food, water, air and all other things. There is an urgent need to solve this for sustaining human life on the earth. The use of environmental biotechnology can help to solve the problem.Biotechnological tools refer to the scientific processes with the chemistry of living organisms. The main mode of action of these biotechnological tools is developing new and alternative methods. The main objective of theapplicationof biotechnological tools in the maintenance of the natural and aesthetic beauty of the environment.The principal areas include the use of biomarkers, bioenergy, bioremediation and biotransformation. Using biotechnology tools can help to save our environment. It can help in purification of air, decrease water pollution, management of waste etc. Appropriate use of this technology has the potential to make our environment free from pollutions.

Keywords: Environment, biotechnology, pollution

1. Introduction

Environmental pollution is a burning problem at the present time. With rapid industrialization and urbanization, the rate of environmental pollution has increased rapidly. Everyday a huge amount of pollutants and toxicants are released into nature. It is affecting all living organisms including humans. The air, water and soil are so much polluted that the existence of life in the earth has become difficult. If it is not controlled immediately, human civilization will be extinct forever. Biotechnological tools refer to the scientific processes with the chemistry of living organisms. The main mode of action of these biotechnological tools in cell manipulation for developing new and alternative methods [1]. The main objective of the application of biotechnological tools in the maintenance of natural and aesthetic beauty of the environment. Appropriate use of technology can help us to get rid of this

situation. In this circumstance, environmental biotechnology can show the right path. In this article, the application of environmental biotechnology tools in solving environmental problems is discussed briefly [2].

Sustainability of the environment: sustainability is the capability of endurance. The origin of sustainability is the Latin word "sustinere" [3]. Environmental sustainability is making the process of environmental interaction resilient and resistant enough so that they can maintain their internal homeostasis properly, so that the environment can be maintained as naturally pristine as possible [4].

2. Application of environmental biotechnology

The different tools used in environmental biotechnology are as follows-

2.1 Biomarkers: Biomarkers can be otherwise called a biological marker. Biomarkers can be used to detect pollution properly[5]. For example, several aquatic organisms are used as pollution biomarkers.

2.2 Bioenergy: The collection of biogases,biomass fuels and hydrogen is called bioenergy.Various sectors like industrial domestic and space sectors are the main consumers of biotechnology [6]. As,we know that, finding clean energy is the basic need of the present era, so green energy generation using wastes collected from the organic and biomass wastes is the main aim.

2.3 Bioremediation: The process of changing the hazardous substances into non-toxic compounds, called bioremediation. It will reduce pollution will offer us a better environment [5].

2.4 Bio-transformation: It is the most used technology in the manufacturing sector where toxic substances are converted into non-toxic by-products [7].

3. Biotechnological approachesin solving environmental problems

The major function of environmental biotechnology is to maintain the environment safe and clean for the purpose of the use of future generations [5].

3.1 Air purification: Air purification can be achieved through mainly [8]

- Photosynthesis which reduces the concentration of carbon-di-oxide.
- Afforestation
- Activities of microalgae.

3.2 Bioremediation of polluted soil and water: Bioremediation of polluted soil and water can be done through bio-absorption/bio-accumulation of heavy metals.Many micro-organisms and higher plants are used for this purpose [9].

3.3 Reduction in environmental pollution: Biotechnology can be used to produce environmentally friendly alternatives as bio-insecticides, bio-fertilizers, bio-degradable plastics and bio-energy which are used for the

purpose of minimizing environmental pollution [10].

3.4 Environmental monitoring: Microorganisms,microalgae, higher plants and lower animals can be used for environmental monitoring as these are very sensitive to certain pollutants [11].As because of their sensitivity, they can also be used as pollution indicator organisms to identify and quantify the effect of pollutants.

3.5 Waste management: Processing of industrial wastes is very difficult, compared to food or plant waste. Biotechnological tools play a very important role in converting industrial Wastes into useful products [12].

3.6 Environmental benefits of biotechnological solution: Biotechnological tools not only reduce costs but also reduce the environmental footprint [1]. Biotechnological tools can be the best weapon for more consumers to explore sustainable solutions.

4. Application of environmental biotechnology

- The great contribution of biotechnology can be seen in the granulation technique which encompasses wastewater treatment technology, optimization of the wastewater treatment system [13].

- Environmental biotechnology has a crucial role in water pollution prevention plans and contributes to the greatest part of the restoration and preservation of the environment [13].

- Environmental biotechnology makes togetherness of researchers,engineers and industry participants to bring out novel technologies in environmental,industrial, agricultural veterinary, mining and medical application [6].

5. Basic research areas of Environmental Biotechnology

5.1 Co-metabolism: co- metabolic processes are a very much difficult branch to study as it requires various novel experimental approaches [4].One important approach among them, utilization of genetic probes, which is used to identify the presence of a metabolic pathway in the co-metabolism [14]. Another one is the use of kinetic evaluation of partial transformation reactions to identify, compare and characterize the bacterial enzyme systems,regarding co-metabolism.

5.2 Bio treatability: Environmental biotechnology provides wide ranges of treatability tests for many soil and water contaminants [15].

5.3 Biotransformation kinetics: Major application of kinetic approaches is to predict microbial population response to pollutant inputs [13].

5.4 Modeling: At present, Environmental Biotechnology does not have a modeling program but trying to develop collaboration with modeling groups[15]. Modeling is also required to understand the function, structure, control and operation of co-metabolizing biological reactors.

5.5 Bioremediation: A great venture in environmental biotechnology: Bioremediation is a branch of biotechnology that deals with environmental-related problems [16].

5.6 Condition of bioremediation: Under 2 conditions bioremediation can take place

- Aerobic conditions.

- Anaerobic condition

In the case ofaerobic conditions, microbes need oxygen to perform their process.

In the case of the anaerobic conditions, oxygen not needed for the performance of their microbes

6. Types of bioremediation

6.1 Mycoremediation: When fungi are used for decontamination of the environment, called mycoremediation.Here actually fungal mycelia used for bioremediation.The selection of proper fungal species is very much important for the success of the myco-remediation [17].

6.2 Phytoremediation: When green plants and their microorganisms are used to decontaminate the environment, called phytoremediation.

Here, we treat the environment with the help of the Polluted and contaminated soil, water and air are the main elements of phytoremediation [18].

6.3 Microbial remediation: When the use of microorganisms can degrade organic contamination, called microbial remediation[19]. Microbial remediation can be done in two different conditions.

6.4 Aerobic condition: When microbes perform in the presence of oxygen.

6.5 Anaerobic condition: In the case of the anaerobic conditions, microbes perform their work without the presence of oxygen [20].

7. Conclusion

Environmental biotechnology can be otherwise called as “white biotechnology”. This is regarded as a broad and expanding field. This branch of science will play a pivotal role in the various sectors as medical, agricultural, environmental, food pharmaceutical and industrial sectors in the future.But careless use of biotechnology can create severe problems against the sustainability of the environment. So, our main motto should be to maximize the benefits of technology and minimize the risk.To, counter against the negativity of this technology, proof and result must be present on the interaction among the release of genetically modified organisms with the environment, humans and animals in nature/environment.

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References:

1. Deplazes-Zemp, A, The conception of life in synthetic biology. Science and engineering ethics, 18(4), 757-774, 2012.

2. Duvick, DN, Biotechnology is compatible with sustainable agriculture. Journal of Agricultural and Environmental Ethics, 8(2), 112-125, 1995.

3. Godani, K, Environmental Biotechnology: Meaning, Applications and other details. Retrieved February 20, 2020, from http://www.biologydiscussion.com/biotechnology/environmental-biotechnology/environmental- biotechnology-meaning-applications-and-other-details/8528, 2019.

4. Galaz, V., Biermann, F., Crona, B., Loorbach, D., Folke, C., Olsson, P., Nilsson, M., Allouche, J., Persson, Å. and Reischl, G., 'Planetary boundaries'—exploring the challenges for global environmental governance. Current Opinion in Environmental Sustainability, 4(1), pp.80-87, 2012.

5. Environmental biotechnology. Retrieved February 15, 2020, from https://www.biotechonweb.com/environmental-biotechnology.html

6. Rittmann, B.E. and McCarty, P.L., Environmental biotechnology: principles and applications. Tata McGraw-Hill Education, 2012.

7. Ivanov, V., & Hung, Y. T. Applications of environmental biotechnology. In Environmental Biotechnology (pp. 1-17). Humana Press, Totowa, NJ., 2010.

8. Burgess, J. E., Parsons, S. A., & Stuetz, R. M., Developments in odour control and waste gas treatment biotechnology: a review. Biotechnology advances, 19(1), 35-63, 2001.

9. Mahakvi, T. L., & Kumar, S., Bioremediation of quizalofop-ethyl by bacteria from polluted soil. Journal of Plant Stress Physiology Vol, 1, 1, 2015.

10. Swaminathan, M. S., Biotechnology, genetic modification, organic farming and nutrition security. Phytomorphol. Golden Jubilee, (51), 19-30, 2001.

11. Gurbuz, F., Ciftci, H., Akcil, A., & Karahan, A. G., Microbial detoxification of cyanide solutions: a new biotechnological approach using algae. Hydrometallurgy, 72(1-2), 167-176, 2004.

12. Kroyer, G. T., Impact of food processing on the environment—an overview. LWT-Food Science and Technology, 28(6), 547-552, 1995.

13. Jördening, H. J., & Winter, J. (Eds.)., Environmental biotechnology: concepts and applications. John Wiley & Sons., 2005.

14. Herdt, R. W., Research priorities for rice biotechnology. Rice biotechnology, 6, 19-54, 1991.

15. Sayler, G. S., Fox, R., & Blackburn, J. (Eds.), Environmental biotechnology for waste treatment (Vol. 41). Springer Science & Business Media, 2013.

16. Nandal, M., Solanki, P., Rastogi, M., & Hooda, R., Bioremediation: a sustainable tool for environmental management of oily sludge. Nature Environment and Pollution Technology, 14(1), 181, 2015.

17. Covino, S., Stella, T., & Cajthaml, T., Mycoremediation of organic pollutants: principles, opportunities, and pitfalls. In Fungal Applications in Sustainable Environmental Biotechnology (pp. 185-231). Springer, Cham, 2016.

18. Salt, D. E., Blaylock, M., Kumar, N. P., Dushenkov, V., Ensley, B. D., Chet, I., & Raskin, I., Phytoremediation: a novel strategy for the removal of toxic metals from the environment using plants. Bio/technology, 13(5), 468-474, 1995.

19. Scragg, A. H., Environmental biotechnology. New York: OXFORD university press, 2005.

20. Gutiérrez-Corona, J. F., Romo-Rodríguez, P., Santos-Escobar, F., Espino-Saldaña, A. E., & Hernández-Escoto, H., Microbial interactions with chromium: basic biological processes and applications in environmental biotechnology. World Journal of Microbiology and Biotechnology, 32(12), 191, 2016.