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Different Ecotypes through a Multi-Biomarker Approach in Bioremediation Potential of Earthworms

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Abstract

Due to their immediate influence on the fate of pollutants, earthworms are a focus of bioremediation research. However, the effectiveness of earthworm-assisted bioremediation largely depends on the sensitivity of the earthworm to the target pollutants and its ability to metabolise the contaminants. Eisenia fetida, a species that lives on the soil surface and feeds on organic waste decaying, has been the species most extensively investigated in soil bioremediation. As a result, its bioremediation capability might only apply to topsoil that is rich in organic materials. We evaluated the ability of three earthworm species, which are epigeic, anecic, and endogeic ecotype representatives, to detoxify against organophosphate (OP) pesticides. In the muscle wall and gastrointestinal tract of E. fetida, specific biomarkers of pesticide detoxification, including esterases, cytochrome P450-dependent monooxygenase, glutathione S-transferase, and oxidative homeostasis total antioxidant capacity, glutathione levels, and glutathione reductase, were measured.

Keywords: Pesticide-detoxifying enzymes; Lumbricus terrestris; Aporrectodea Caliginosa; Eisenia Fetida; Oxidative stress biomarkers; Bioremediation potential; Native page

Introduction

Anecic Lumbricus terrestris and endogeic Aporrectodea caliginosa [1]. According to our findings, L. terrestris was the best species to use in the bioremediation of OP-contaminated soil because of the following: 1 L [2]. terrestris had higher gut carboxylesterase activity than E. fetida, although E. Fetida's muscle CbE activity was more sensitive to OP inhibition, indicating a higher potential to inactivate the hazardous oxon metabolites of OPs. 2 L. terrestris had much larger phosphotriesterase activity than the other species in both the stomach and muscles [3]. In comparison to E. fetida and A. caliginosa, the levels of the enzymes catalase, glutathione, and GR were 3- to 4-fold higher in L [4]. Terrestris, indicating a greater ability to maintain the cellular oxidative homeostasis against reactive metabolites [5]. A product of OP metabolism. These toxicological characteristics, along with biological and ecological characteristics, point to L. terrestris as a more suitable choice for soil bioremediation than epigeic earthworms [6]. The ability of microorganisms to cometabolize substances, exoenzymes synthesis, microbial sensitivity to pollutants, and contaminant bioavailability all play a role in the bioremediation of pesticide-contaminated soils [7]. The effectiveness of bioremediation is currently increased by a variety of chemical and biological techniques that encourage soil microbial activity [8]. The most naturally compatible methods among them, with pronounced positive effects above probable negative side effects, are plants and earthworms [9].

Discussion

Through three main processes the stimulation of soil microorganisms and earthworm gut symbionts that can break down contaminants, the alteration of soil organic matter that provides molecular ligands for pollutant immobilisation, and the earthworm's ability to bioaccumulated and detoxify organic pollutants earthworms specifically facilitate the degradation or immobilisation of organic contaminants [10]. Earthworms are the perfect creatures for nature-based bioremediation methods because of their effects on the fate of pollutants [11]. However, the majority of laboratory-scale vermiremediation researches comprise Earthworm species that live on the soil's surface and Lumbricus, whose ability to remove toxins from the soil may be constrained [12]. Effectiveness of vermiremediation is influenced by the gut microbiota of earthworms and other environmental and biological parameters [13]. According on their food preferences and ability to burrow, earthworms are typically divided into three ecological groupings called epigeic, endogeic, and anecic [14]. These organisms alter the microbiota of the earthworm stomach, which affects the bioavailability and biodegradation of pollutants [15]. According to several researches, the earthworm gut microbiome and soil microorganisms interact exquisitely, with the population dynamics of the microbes in the gut being heavily influenced by soil nutrients, gut colonisation by soil microorganisms, and earthworm ecotype. Similar to this, earthworms contribute nutritious castings to the soil that contain intestinal bacteria, changing the microbial community. Consequently, it wouldn't be a bad idea. Because there are noticeable changes in feeding patterns, burrowing activity and the microbial community associated with the drilosphere, to infer that contaminant degradation will rely on the earthworm ecotype. The earthworm's susceptibility to organic contaminants is another important element affecting the efficacy of vermicomedication. Earthworm sensitivity to toxins like pesticides should be taken into account when designing earthworm-assisted bioremediation measures, according to two meta-analysis studies. Pelosi discovered that the earthworm species suggested in standardised soil toxicity testing are less sensitive to pesticides than other species, such as Aporrectodea caliginosa or Lumbricus terrestris, by a comparative examination of LC50 values (anecic).

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Conclusion

More recently, a comparative toxicological investigation showed that endogeic earthworms like A. caliginosa are more vulnerable to the pesticides imidacloprid, permethrin, and Chlorpyrifos than are epigeic species. Suggested that rather than environmental parameters like soil organic matter and nitrogen levels, soil texture, or pH, earthworms' potential capacity to be exploited as biological vectors of soil bioremediation relied on their sensitivity to organic contaminants. All of these research point to the need for soil vermiremediation to take into account the earthworm's sensitivity to organic pollutants, especially pesticides, and its capacity for detoxification. Despite ongoing efforts to limit agrochemical input, agricultural chemicals have a significant impact on soil fauna. m Despite their high acute toxicity, organophosphate insecticides are nevertheless necessary to control agricultural One of the best ways these substances can be dangerous to humans is to suppress the activity of the hydrolase enzyme acetylcholinesterase, which is found in the chemical synapses between the nervous system and the neuromuscular junction.

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Conflict of Interest

None

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