African Journal of Food Science and Technology (ISSN: 2141-5455) Vol. 12(11) pp. 01-02,
December, 2021
DOI: http:/dx.doi.org/10.14303//ajfst.2021.056
Available online @https://www.interesjournals.org/food-science-technology.html

Commentary

Contamination of plants and the food chain with hazardous heavy metals: The role of long-term cleanup methods

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Abstract

Because of the broad sustainability and applicability, toxic metal cleanup technologies are highlighted in this review. Hazardous and invisible heavy metals can be incorporated into all segments of the environment, including soil, water, air, and plants, as a result of rapid developmental processes. The discharged hazardous heavy metals (HHMs) entered the food chain and were biomagnified into living beings through the ingestion of food and vegetables, posing a health risk. Physical and chemical rehabilitation methods are limited and localised, and they are mostly used on wastewater and soils rather than plants.

More rectification and sustainability are required through nanotechnological, biotechnological, and genetical procedures. Understanding the routes and interactions that lead to the buildup of potentially toxic metals (TMs) at the cellular, molecular, and nanoscale. These methods could lead to the production of crop varieties with significantly lower TM concentrations in their edible fruits and vegetables. Authors found that nanoparticles have a high adaptability for both in-situ and ex-situ cleanup of hazardous heavy metals (HHMs) in the environment in a critical analysis.

Keywords: Rehabilitation, Contaminated, Phytoremediation, Biomagnified.

INTRODUCTION

More than 10 million sites covering more than 20 million ha of land worldwide are classified as soil polluted, with >50% of them contaminated with hazardous heavy metals (HHMs) and/or metalloids. According to a study conducted by China's Ministry of Environmental Protection (MEP), the total area of arable land contaminated with heavy metals had reached nearly 20 million hectares, with nearly 16.1% of total arable land and 19.4% of recognised cropland locations exceeding the normal range of heavy metals accumulation. Furthermore, modest, mild, moderate, and heavy pollution levels were found in 13.7 percent, 2.8 percent, 1.8 percent, and 1.1 percent of arable land, respectively(Kim et al., 2017). According to India's Central Water Commission (CWC), at least two HHMs exceed the allowed limit in 42 rivers (CWC, 2018). According to India's Central Ground Water Board (CGWB), heavy metal toxicity with cadmium (Cd), chromium (Cr), and arsenic affects groundwater in more than 718 districts (As), Iron (Fe) and lead (Pb) (Fe). Heavy metals in contaminated soils degrade natural ecosystem services and, as a result, harm human health through the food chain(Klaassen et al., 1999).

Industrialization, mining, milling, fossil fuel burning, and agrochemicals are the principal drivers of heavy-metal pollution, which release a variety of HHMs such as As, Cr, mercury (Hg), Cd, copper (Cu), nickel (Ni), cobalt (Co), zinc (Zn), and Pb into agricultural soils and water bodies. Because of their high content of beneficial and needed minerals and nutrients, vegetables are an important part of the human diet. Unfortunately, plants can absorb and collect HHMs throughout their entire body, including both edible and inedible sections, exceeding the acceptable limits(Klaassen et al., 2009). HHM concentrations in vegetables (leafy, root, and fruit) have been found to be extremely high in recent years. Because of the damaging and permanent effects of metals on both humans and animals' overall health, the build-up of HHMs in vegetables and edible sections of crops in contaminated soils is a severe problem.

Several physicochemical ways of removing HHMs from industrial wastewaters and polluted soils have been explored for many years, including filtration, evaporation, reverse osmosis, ion-exchange, redox processes (oxidation and reduction), precipitation, and electrochemical removal. Hazardous metal contamination in vegetables and plants, and subsequent decontamination, lie within the investigation stage of research and are not deemed essential enough by local community governments to develop a realistic remediation strategy(Kher et al.,2011).

Physical and chemical remediation methods are limited and localised, and they are mostly used on wastewater and contaminated soils, not on any plant life that may be present. Some phytoremediation techniques have been studied extensively; however they are not suitable for culinary crops and vegetables.

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