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Short Review Paper

Arsenic Resistance Bacteria in Groundwater: A Review

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Abstract

Arsenic pollution in our ecosystem is nowadays a severe risk effecting to human population. Millions of people across the globe unknowingly depends on arsenic contaminated groundwater for drinking purpose and facing serious health hazards. The groundwater is known to be contaminated from different xenobiotic and anthropogenic sources leading to fatal diseases as cancer and skin lesions. Arsenic in the form of arsenate (IV) and arsenite (As III) is toxic in water sources. Presence of microbial biome such as E. coli, Pseudomonas, and Actinobacter helps to reduce the arsenic in ground water. This paper aims to seek a review on global arsenic contamination and presence of arsenic resistance bacteria in groundwater.

Keywords: Arsenic, groundwater, microbes, reduction, health.

Introduction

Rising of urbanization, industrial pollution, burning of fossil fuels elevated the range of arsenic in the biosphere. Concentration of arsenic is found to be high in rainfall thus troubles to groundwater. In Asian countries including India arsenic polluted groundwater is being used for drinking and irrigation[1]. Estimation of fifty million population in Bangladesh depends on arsenic contaminated tube wells and suffering from severe chronic diseases including cancer[2]. Dissolution of Fe, Mn oxyhydroxide, $NaHCO_3$, DOC and high pH are the main factor of As mobilization in ground water[3]. Elevated form of arsenic in water sources results in a stress livelihood to a society including poverty and a drop of agricultural products[4]. Volcanic eruption and hydrothermal sources cause a major role in arsenic contamination to the environment[5]. In most districts of West Bengal (India), it was reported that water used for drinking and agricultural purpose were elevatedly affected by arsenic. A positive correlation of arsenic concentration between soil and water was also seen[6]. To equalized the arsenic contamination, arsenic resistance gene of bacterial species are found to remain associated with Ars operon. These moiety are As(III) genes responsive regulation on (ArsR), As(III) efflux permease (ArsB or ACR3) that expel As (III) from the cell[7]. Bas1 and Bas2 two bacterial strains isolated that can convert the toxin As(III) to non toxic As(V) and is reported to be used in bioremediation process[8] . *Bacillus* species BAR1 was also isolated from arsenic polluted groundwater which reported to be resistant to arsenic and also resistance to other Cu, Cd, Ni, Hg, Zn heavy metals.[9]. *Pseudomonas, Bacillus, Psychrobacter, Enterobacter, Vibrio* show a elevated resistance capacity for As with a minimum inhibitory concentration from 2-200Mm[10]. A study in Hetao plain, Inner Mongolia reflected the presence of Pseudomonas and Acinetobacter in a dominated pause of both high and low As groundwater[11]. High As resistant bacterial strains- *Actinobacteria, Microbacterium, Pseudomonas and Rhizobium* were localized in ground water of West Bengal (India) showing minimum inhibitory concentration of about > 10mM[12]. Arsenate reductase activity is seen to be influenced by *Agrobacterium, Achromobacter, Rhizobium, Ochrobactrum* starins isolated from arsenic contaminated groundwater of West Bengal (India)[13].

Arsenic Mobilization

Arsenic release in environments occurs due to weathering of rocks, minerals (arsenopyrite) and anthropogenic sources. Mobilization of arsenic in ecosystem is influenced by hydrogeochemical reactions, and redox reactions carried by potential micro biomes. Elevated form of arsenic is found with high concentration of Fe oxide and pyrites[4]. Sulphate and iron reduction isolates *Deltaproteobacteria* , *Nitrospirae* were found positive in arsenic mobilization[14]. Phosphatase and siderophores play a crucial role in release of As(V) and As(III) is reduced by arsenate reductase to mobilize arsenic in groundwater[13]. Oxalic acid assemblance and As(V) reductase of *Brevundimonas, Flavobacterium, Rhodococcus, Methyloversatilis, Methylotener, Pseudomonas* and *Polaromonas a* lead to mobilized arsenic in wide range[15]. *Acidovorax, Acinetobacter, Bosea, Bacillus, Brevundimonas, Caulobacter Herbaspirillum, Pseudomonas, Staphylococcus, Ralstonia, Rhizobiales, Rhodococcu, Undibacterium* found to used the carbon source and grow chemolithotropically enhancing the arsenic mobilization in groundwater[16]. PO_4^{3-}, SO_4^{2-}, HCO_3^-, carbonate dissolution and Fe-oxyhydroxides important factor of reduction influences mobilization of arsenic[17]. Arsenic contamination in groundwater is geogenic and may triggered by Fe(III) oxides and sulphide oxidation[18].

Global Health Risk

Increasing of anthropogenic and xenobiotic activities by human, arsenic contamination in groundwater is now in elevated form. Infectious health hazards is a stressed for human population that depends mainly on natural water sources. Arsenicosis-nearby uncurable disease includes skin lesions, cancer in lungs, liver, urine and kidney is nowadays a serious issue to humans[19]. Mee lines symptom is mostly occurable in fingernails due to arsenic toxicity resulting in various cardiovascular diseases. Diabetes and pregnancy outcomes such as child mortality is an another cause factor of arsenic toxicity in drinking water. High arsenic exposure to drinking water also leads to chronic respiratory problems such as cough, breathing problem etc. Contaminated arsenic water used for irrigation purpose is passed to our nutritional crops. Cattles feeding on arsenic pollued water sources face a vulnerable death.

Conclusion

Majority of the human population is now depending on high contaminated arsenic groundwater as for drinking purposes. Lack of education regarding the toxic effect of such heavy metals present in water is one of a major cause of rise in serious health hazards. Baterial novel strains such as *Actinobacteria, Microbacterium, Pseudomonas* and *Rhizobium* can be a superior technology for bioremediation of arsenic toxicity in groundwater.

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