Keywords: Carcinogenic effect; Arsenate; P. vittata; Aquaglyceroporins

Arsenic contamination in non-effected area is of great concern today and spreading via food chain. Old strategies for arsenic mitigation were not only costly, but also results in large amount of sludge production, which was difficult to detoxify in one-step. Many worker believes that comprehensive multistep approaches towards escalating problems is essential in mitigation of arsenic means both chemical as well as biotechnological approaches can work in synchronous matter. Therefore, alternative techniques may be helpful in order to prevent the entry of arsenic in the food chain. One of the most relevant strategies seems to be the application of arsenic resistance microbes equipped with both uptake and detoxification machinery for sequestration and hyper accumulator's plants have role in mobilization of arsenic. Metagenomics approaches seems to be plausible in finding potential microbes in order to enhanced bioremediation capability of arsenic on the basis of presence of clusters of genes and gene networks present.

Figure 1: Countries affected with Arsenic metal in groundwater [15].
for As sequestration and metabolism [3]. Many hyper accumulators are known to adsorb more than 95% of the arsenic from the soil as evident by the fern (P. vittata) [4]. Unfortunately, the plant P. vittata grows well only in warm, humid environments with mild winters, therefore they cannot grow everywhere in every environment. Therefore, some scientist are making efforts to increase the ability of plants to pump out arsenic from soil via creating GMO plants which have gene for arsenic V enters via phosphate transporter protein while Ars operon. Actually, these operons are linked with efflux and transporter protein, conversion to As (III) via arsenic reductase, which triggers ars operon.

Table 1: Sources and forms of arsenic.

| Arsenic form | Sources | Comments | References |
|-------------|---------|----------|------------|
| Sodium Arsenate | Pesticides and wood | | [27] |
| DMA (also known as cacodylic acid) | Preservatives | | [28,29] |
| Arsenopyrite | Rocks, Soils, Minerals, mines | | [15,49] |
| Arsenobetaine, Arsenocholine, tetrakis(β-d-gluco-pyranosyl) arsenobetaine, arsenocholine, and S-(β-d-gluco-pyranosyl) arsenecholine | Ground water | Arsenite, arsenate | [30] |
| Arsenosugars | Coal-fired power generation | Organic forms (methyl and dimethyl arsenic compounds) | [31] |
| Fe-reducing bacteria | Plants, burning vegetation and also due to eruption of volcano | | [32] |
| Fe-reducing bacteria | Tube-wells >1 mg L^{-1} | Bengal Delta region (encompassing Bangladesh and West Bengal) | [33] |
| Metal-reducing bacteria | Marine animal | | [34] |
| [(CH₂)₂As+CH₂COOH] dimethylarsinic acid | Soil | | [35] |
| arsenobetaine MMA, DMA, TMAO | Plants | | [36] |
| Arsenic III, DMA, MMA, MA As-cysteine, As₃S₈, and AsO₂⁻ | Plants | | [37-39] |
| arsenate, arsenite, MMA and DMA | Soil, rice | No harm by intake | [40,41] |
| As(V), DMA,MMA, As(V) | Urine wine club soda | | [42] |
| Legume–rhizobium | Sunflower | | [43] |
| Symbiosis | (Helianthus annuus L.), jack bean (Canavalia ensiformis L.), velvet bean (Stizolobium ateninum L.), castor bean (Ricinus communis L.) | | [44,47] |

For arsenic detoxification arsenate and arsenite operon is present in both the gram positive as well as gram negative bacteria, arr operon is related to arsenic reductase present in many microbes such as Shewanella, bacillus some organism like E. coli, Staphylococcus, Bacillus, Acidithiobacillus, Pseudomonas, had well characterised Ars operon linked with As(V) detoxification where. In these organisms, As (V) is converted to As (III) via arsenic reductase, which triggers ars operon. Actually, these operons are linked with efflux and transporter protein, as a result arsenic V enters via phosphate transporter protein while Ars III is efflux after activation of Ars operon [16]. Endophytes are part of plant system and thus may help in mobilisation of nutrients and arsenic along with Arsenic V which is analogous to phosphate while some rhizospheric endophytes stops mobilization of arsenic metals. There is more bioavailability of arsenic or deposits of arsenic. Rather than...
single microbes to act for decontamination groups of microbes (called as Biomass) activates for maintaining balance between toxic metals. Recently, addition of SiO,

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