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A REVIEW ON ISOLATION AND CHARACTERIZATION OF IRON OXIDIZING THIOBACILLUS FERROXIDANS BACTERIA FROM SAKKARDARA LAKE SOIL

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ABSTRACT:
Iron oxidizing bacteria such as *thiobacillus ferroxidans* and *Staphylococcus hominis* was able to tolerate and grow in the contaminated soil. Iron is a chemical element that is found in almost every place on earth, including well water or groundwater. Iron can be suspended in water with organic substances or inorganic soilds in the form of ferrous cations (Fe^{2+}) and ferries (Fe^{3+}). In this review, we are studying about the types and techniques which are used to reduce the content of iron in groundwater as well as well water. Fe-oxidizing bacteria has ability to accumulate iron content in ground water. A major challenge is to measure contents of iron in organic complexes and observing the interaction between bacteria and iron. Therefore, development and testing of new analytical techniques and an integrated approach between soil biology and soil chemistry are essential. This review suggested that isolation and characterization of iron oxidizing bacteria from lake soil is an important aspect.

Keywords: - Iron oxidizing bacteria, Biomineralization, Bioaugmentation, Ferrous and ferric iron.

INTRODUCTION:

Iron, a common and redox-active transition metal in sedimentary environments, plays a crucial role in various biological and geological processes (Froelich et al., 1979; Canfield et al., 1993). It is essential for numerous cellular functions in both eukaryotic and prokaryotic organisms and can act as an electron donor or acceptor for many prokaryotic species (Kappler and Straub, 2005; Weber et al., 2006a; Konhauser et al., 2011). In particular, in freshwater lakes with low sulphate levels, microbial reduction of Fe(III) is a key mechanism in the anaerobic breakdown of organic material (Thamdrup, 2000; Lovley et al., 2004). Freshwater lakes, covering about 0.8% of the Earth's surface (Dudgeon et al., 2006) often have iron-rich, redox-stratified sediments that provide an ideal environment for Fe-metabolizing bacteria. In these sediments, bacterial processes consume Fe(III) and other oxidants in a specific order based on the energy produced per mole of organic carbon oxidized (Froelich et al., 1979; Canfield and Thamdrup, 2009). Iron(II)-oxidizing bacteria are abundant in many freshwater lakes and sediments (Straub and BuchholzCleven, 1998; Diez et al., 2007) Among them, neutrophilic nitrate-reducing Fe(II)- oxidizers are especially numerous (Hauck et al., 2001; Muehe et al., 2009) producing poorly crystalline Fe(III) hydroxides (ferrihydrite) or more crystalline forms like Fe(III) oxyhydroxides (goethite, lepidocrocite) as products of Fe(II) oxidation (Straub et al., 2004; Kappler et al., 2005b; Larese-Casanova et al., 2010).

Bacteria inhabited in soil are integral part of global geochemical cycles and mineral solubilization which is important to soil property and crop development.Release of certain heavy metals from the waste dumps results in change bacterial community structure of mining area and generates assumption with presence of certain unique bacteria. Some specific human activity areas such as mining area may

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represent some unique sulphur and iron oxidizing bacteria with unique potential. Genus *Thiobacillus* is well characterized sulphur and iron oxidizing bacteria and obtained energy by oxidation of reduced sulphur and iron respectively. Iron exists in two oxidation states i.e.(Fe^{+2} and Fe^{+3}) naturally and interconvert based on surrounding physicochemical parameters and biological population. Some sulphur and iron oxidizing bacteria are found with ability to grow in high salt concentration of 4M NaCl (Wood A P & Kelly D P et al.,1991) , high temperature of 90^{0}C and high concentrations heavy metals (Gaballa A et al.,2003). Cultivation of heterotrophic bacteria was carried, and microorganisms and microorganisms belong to *pseudomonas, Bacillus,* and *Micrococcus* genera were identified in selenga River sediments (Namsarayev et al., 1994). In this study the bottom sediment of Delta Selenga River were microbiologically and chemically described. The role of microorganisms in silicon cycles is discussed.

The corresponding review is chosen for exploring and understanding various impacts of iron oxidized bacteria on lake soil microbial community as well as its effect of various concentrations on Neutrophilic bacteria. The following literature reviews are studied to gain the understanding of the research and to present that study so that new ideas related to research can be framed.

Reduction of iron content :

Adsorption Technique :

The decrease in iron content by the adsorption technique occurs because there is an ion exchange process and the binding of Fe^{2+} metalin the pores of the manganese greensand media and is followed by a filteration technique using activated carbon.

Filteration Techniques :

The derease in iron content in the filteration technique is due to filtering by the ceramic or sand filtering media used as the filteration medium. That filteration is used to separate impurities (particulates) that can be in the water. The dissolved colloid materials is likely to be captured due to the electrokinetic force. Many of the dissolved materials cannot from a floc and the deposition of the lumps enters the filter and is filtered.

Coagulation Technique :

The reduction in iron levels with the coagulation technique is due to the collision process between coagulant media such as negatively charged moringa seeds and positively charged colloids (iron) so that it will form a precipitate.

Iron reduction by mixed and pure cultures of *Chemolithotrophy Bacterium* :

It was extremely difficult to obtain pure cultures of anaerobic, chemolithotrophic bacteria which reduced Fe(III). An enrichment culture in which H_2 was the source of reducing power, and CO_2 the source of C, reduced Fe(III) the only potential electron transport acceptor in the medium. It was a facultative anaerobe and a facultative autotroph. Growth was enhanced by the precence of yeast extract but has been so slow, or has not occurred on conventional media that further characterization has not been possible.

Maximum Fe(II) oxidation rates :

When we compare the Fe^{2+} oxidation rate attained by bacteria which are cultivated in pure cultures and the rate obtained in environmental systems, it is expected that the oxidation rate attained by bacteria cultivated in pure cultures is higher. i.e. they have enough nutrients and space require to grow. However, the maximum Fe(II) oxidation rates calculated from pure culture studies were significantly lower, by two to four orders of magnitude, than those observed in the microcosms with littoral sediments.

Fe acquisition by plant and microbes :

Microbes and Fe oxides coexist in soils, and their close association provides ample opportunities for mutual interactions, where primary minerals may provide Fe and many other important nutrients like P and S in addition to appropriate habitats for microbes while microbes may influence mineral weathering. Thiobacillum sp.the ability to dissolve iron containing primary minerals and Metallogenium sp., a weathering factor. Fe minerals and microbes as a consequence of root activity (exudation and nutrient uptake) to satisfy their need of this essential micronutrient.Therefore, the low supply of Fe^{III} to the soil solution and high demand of plants and microorganisms (for their intense growth) could induce a considerable level of competition for Fe.

Role of iron in colouration :

Iron present in drinking water it is seldom found with concentrations >10mg/l. However as little as 0.3mg/l it can cause water to turn reddish brown in colour a phenomenon observed in Mbiame (MBI) where clear water samples turned reddish to brown a short while after exposure to air. Iron is mainly present soluble in the Fe^{2+} state while insoble in the Fe^{3+} state. Water with Fe^{2+} is slightly clear (with faint greenish colour) but on exposure to air the water turns reddish brown because the Fe^{2+} state is oxidized to the more stable Fe^{3+}.

Colony morphology :

Different colony morphology and Gram staining properties were observed as Visible colony of iron oxidizing bacteria was observed in low iron containing medium with yellow pigmentation.

Gram positive bacteria shows Yellow Circular Raised and Entire Moist colour colonies. While Gram negative bacteria shows White (black pigment) Circular Flat and Entire Moist.

CONCLUSION :

The isolation and characterization of iron-oxidizing bacteria from lake soil reveled a diverse range of species, including Gallionella, Thiobacillus Ferroxidans, sideroxydans, and Pseudomonas, which play a significant role in iron cycling and ecosystem balance. The findings of this study contribute to our understanding of the microbial ecology of lake soil and have implications for biogeochemical research, environmental monitoring, and biotechnological applications. The present study successfully isolated and characterized iron-oxidizing bacteria from lake soil.

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