

ABSTRACT

There is an utter need to countersign a sustainable process for humanity with an eco-friendly influence. The present study was an endeavor to deal with the application of indigenous bacterial flora in the form of isolated strains to lessen the intimidations of pollution to the aquatic ecosystem. First part of the research was intended to achieve a healthier endorsement about the process of bioremediation dealing with a wider range of wastewater types *i.e.*, domestic, hospital, textile, pharmaceutical and mixed wastewaters. All five samples were collected at the same time and labelled. The wastewater samples were assessed for their physicochemical parameters to estimate the amount of contamination present in the wastewater before and after the experiment *i.e.*, temperature, colour, odour, pH, EC, salinity, turbidity, chemical oxygen demand (COD), biochemical oxygen demand (BOD), biodegradability index (BI), total dissolved solids (TDS), total suspended solids (TSS) and heavy metals estimation (As, Cd, Cr, Pb and Ni). Through the serial dilution method, the five wastewater samples were used for bacterial isolation. From 5 wastewater samples under study, thirty-seven bacterial isolates were witnessed. From 37 initially isolated bacterial strains, three bacterial isolates *i.e.*, D6, D7 and P1, were screened out which exhibited significant decolourisation potential against collected wastewaters. The three screened isolates were identified through 16S rDNA sequencing. Isolates D6 and D7 showed 100 and 99.86 % homology to *Bacillus paramycooides* spp., novel strains from the *Bacillus cereus* group. Isolate P1 showed 97.47 % homology to *Alcaligenes faecalis*. Under optimum growth conditions, the isolates D6, D7 and P1 showed maximum decolourisation potential of 96, 96 and 93% respectively against hospital wastewater. Untreated hospital wastewater revealed the presence of pharmaceutical pollutants in GCMS analysis *i.e.*, Phenol (876 µg/L), Salicylic acid (48 µg/L), Caffeine (7 µg/L), Naproxen (23 µg/L), Octadecene (185 µg/L) and Diazepam (14 µg/L). The analysis of treated hospital wastewaters showed high degradation percentages suggesting strong biodegradation ability of bacterial strains under study. The strains also showed significant metal tolerance limits against metal salts such as PbNO₃, CoCl₂, CaCl₂, ZnSO₄, MnSO₄, MgSO₄, FeSO₄, CuSO₄, K₂Cr₂O₇ and Na₂MoO₄. The overall maximum growth of *B. paramycooides* D6 was 78 and 70 % at 300 mM concentration of CaCl₂ and MgSO₄, respectively. *B. paramycooides* D7 exhibited maximum growth of 82 % at 300 mM concentration of PbNO₃. *Alcaligenes faecalis* demonstrated maximum growth of 65, 90, 73, 73 and 75 % at 300 mM concentration of PbNO₃, Na₂MoO₄, CaCl₂, MgSO₄ and K₂Cr₂O₇, respectively. The second part of the research was related to hospital wastewater effect on the seed germination different crops *i.e.*, food crops [*Raphanus sativus* L. (Radish) var. Radish Minto Early, *Brassica oleracea* L. (Cauliflower) var. Cauliflower 2801, *Lycopersicon esculentum* L. (Tomato) var. Seminis Hybrid Tomato ONYX, *Capsicum annum* L. (Hot pepper) var. Seminis Hybrid Hot pepper SKY LINE 3], cash crops [*Triticum aestivum* L. (Wheat) var. FSD-2008 and *Oryza sativa* L. (Rice) var. PS-2 (PK-112)] and fodder crop [*Trifolium alexandrianum* L. (Berseem clover) var. Anmol]. The different concentrations of untreated and treated hospital wastewater (25, 50, 75 and 100 %) were used to irrigate these crop seeds. The results showed a significant phytotoxic reduction in the crop plants grown in treated hospital wastewater in terms of germination percentage (GP), delay index (DI), germination index (GI), stress tolerance indexes (STIs), seedling vigour index (SVI) and phytotoxicity index (PI). The result also confirmed the usefulness of the bacterial consortium to be used for hospital wastewater treatment before crop irrigation. The present research work directly links the hydrosphere with the biosphere and anthroposphere. These strains therefore could represent a low-cost and low-tech alternative to bioremediate complex wastewaters before irrigation to support the achievement of the Sustainable Development Goal 6 - clean water and sanitation in Pakistan.