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WATER LILY (*NYMPHEA ODORATA*) AS A TOOL FOR PHYTOREMEDIATION OF CRUDE OIL CONTERMINATED WATERS

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ABSTRACT: Phytoremediation of oil-polluted fresh and marine aquatic environment using *Nymphea odorata* was studied**.** The aim was to ascertain the possibility of using the plants in the treatment of crude oil contaminated waters and the duration required for the restoration of the desired water quality. The experimental approach involved the exposure of the plants to varying concentrations of crude oil (500mg/l, 2500mg/l and 5000mg/l) under laboratory conditions. From the result, THC percentage reductions achieved were 80.25, 82.55 and 83.62 percent with 500mg/l, 2500mg/l and 5000mg/l of crude oil respectively, after six weeks of treatment with *Nymphea odorata*. The result therefore reveals that six weeks after contamination and exposure of *Nymphea odorata*, removal of the crude oil and the restoration of the desired water quality was achieved. This study has shown that *Nymphea odorata* has great potentials in enhancing phytoremediation of crude oil contaminated waters and the restoration of the water quality, without negative effects on the medium. Thus, *Nymphea odorata* can therefore serve as an agent of phytoremediation in crude oil contaminated waters.

KEYWORDS: Water Lily, Phytoremediation, Total Hydrocarbon

INTRODUCTION

Nigeria has being experiencing increases in her oil and gas exploration, refining and products marketing. The onshore activities mainly in the Niger Delta of Nigeria have being experencing recurrent oil spills from oil pipeline vandalization, tanker accidents and accidental rupture of oil pipelines. These mishaps result in the release of crude oil and refined petroleum products into the terrestrial and aquatic environments (Okpokwasili and Amanchukwu, 1988). Despite more stringent environmental regulations, the risk of an oil spill affecting these ecosystems is still high and which we must accept as inevitable (Kinako, 1988; Venosa and Zhu, 2002). For possible elimination of these effects, it is imperative to clean up these pollutants from the environment by applying remedial measures (Ellis *et al*., 1990). Phytoremediation has emerged as a highly promising secondary treatment option for oil removal. These plants are harnessed to bring about degradation of the crude oil. This research attempts to determine the use of *Nymphea odorata* in the treatment of crude oil contaminated waters.

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MATERIALS AND METHODS

All samples were analyzed as described in Standard Methods for the Examination of Water and Wastewater (APHA, 2005). At commencement of the experiment twelve tubs (20 liter capacity) were used as experimental tubs. Before use, the tubs were thoroughly washed with detergent and finally rinsed with distilled water. The tubs were filled with water and replicated into 3 micro plots. The aliquots of the pollutant (crude oil) obtained from Nigeria National Petroleum Corporation, Port Harcourt was applied to 20liters of water as follows; 10mls (500mg/l) (low intensity), 50mls (2500mg/l) (medium intensity) and 100mls (5000mg/l) (high intensity). Two experimental runs were conducted on the water samples prior to contamination and after six weeks of contamination. Furthermore, approximately 0.25kg weights of water hyacinths () stock were introduced into each of the tubs. The roots of plants were washed thoroughly in running tap and plants were left in running tap water for 48 hours to regain normal growth. Finally two experimental runs were also conducted on the plants before exposure to crude oil and after six weeks of detention time.

RESULTS AND DISCUSSION

Table 1 shows the results of water sample characterization prior to contamination and mean values and percentage reductions for all parameters analyzed. The pH of the water samples containing *Nymphea odorata* used as control was 6.12 before contamination and 6.20 after six weeks of treatment with *Nymphea odorata* while the contaminated water samples revealed that the pH were 6.14, 6.18 and 6.19with 500mg/l, 2500mg/l and 5000mg/l respectively after six weeks of treatment with *Nymphea odorata*. The range obtained were within the optimum range (pH 6-8) for biodegradation to occur (Mentzer and Ebere, 1996). Dissolved oxygen (DO) for water sample used as control was 5.58mg/l before contamination and 6.24mg/l after six weeks of treatment with *Nymphea odorata* . Furthermore the DO mean values for water sample contaminated with 500mg/l, 2500mg/l and 5000mg/l were 5.97mg/l, 5.83mg/l and 6.70mg/l respectively after six weeks of treatment with *Nymphea odorata* . This revealed that there could have been re-aeration of the water occasion by exposure to the atmosphere and the release of oxygen during photosynthesis by the plants. Biochemical oxygen demand (BOD) for water sample used as control was 5.78mg/l before contamination and 4.20mg/l after six weeks of treatment with *Nymphea odorata* while the BOD percentage reductions achieved for contaminated samples were 80.25, 82.20 and 85.45 percent with 500mg/l, 2500mg/l and 5000mg/l of crude oil respectively after six weeks of treatment with *Nymphea odorata* . Chemical oxygen demand (COD) for water sample used as control was also 7.55mg/l before contamination and 7.86mg/l after six weeks six weeks of treatment with *Nymphea odorata* while the results achieved for contaminated water samples after treatment were 98.50, 99.45 and 99.24 percentage reduction with 500mg/l, 2500mg/l and 5000mg/l of crude oil respectively after six weeks of detention time. The result shown for both BOD and COD revealed that *Nymphea odorata* could have contributed in the removal of both BOD and COD and also various factors such as; nutrient enrichment, continuous aeration, sunlight amongst others could have influence the high rate of removal. Total organic carbon (TOC) for water sample used as control was 270mg/l before contamination and 265mg/l. after six weeks of treatment with *Nymphea odorata* . Furthermore TOC percentage reductions achieved for contaminated samples were 85.48, 82.60 and 84.25 percent with 500mg/l, 2500mg/l and 5000mg/l of crude oil respectively after six weeks of introducing *Nymphea odorata* . Thus, the result revealed that

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Nymphea odorata could have contributed to the high percentage reductions achieved after treatment. The temperature for control samples before contamination and after six weeks of treatment with *Nymphea odorata* was 30oC while for contaminated water samples the mean values were 30 ^{o}C, 30^{o}C and 30^{o}C, with 500mg/l, 2500mg/l and 5000mg/l after six weeks of treatment with *Nymphea odorata* . Thus the temperature range obtained for the study was within the range stipulated by other workers (Mentzer and Ebere 1996) for increase in hydrocarbon biodegradation to occur. Total hydrocarbon content for water sample used as control was 0.001mg/l before contamination and 0.00mg/l after six weeks six weeks of treatment with *Nymphea odorata* . Percentage reductions achieved for THC were 80.25, 82.55 and 83.62 with 500mg/l, 2500mg/l and 5000mg/l of crude oil respectively after six weeks of treatment with *Nymphea odorata* . This probably resulted from the plants ability to degrade petroleum hydrocarbon and related compounds. The nitrate for water samples containing *Nymphea odorata* used as control was 3.22 mg/l before contamination and 3.55mg/l after six weeks of treatment with *Nymphea odorata* while for contaminated water samples percentage reduction achieved were 80.42, 85.60 and 84.55 percent with 500mg/l, 2500mg/l and 5000mg/l after six weeks of treatment with *Nymphea odorata* . Furthermore the phosphate for water samples containing *Nymphea odorata* used as control was 0.61 mg/l before contamination and 0.42mg/l after six weeks of treatment with *Nymphea odorata* while for contaminated water samples percentage reduction achieved were 83.76, 81.58 and 85.20 percent with 500mg/l, 2500mg/l and 5000mg/l after six weeks of treatment with *Nymphea odorata* . Thus the result of both nitrate and phosphate revealed that *Nymphea odorata* contributed in the removal of nitrate and phosphate thus having water -purifying potentials hence eutrophication of the medium did not occur.

Table 1: Results Showing Water Sample Characterization and Mean Values and Percentage Reductions (*) Before and After 6 Weeks of Contamination and Treatment.

Parameters	**Water Sample Characterization**	**Mean Values and Percentage (*) Reductions Achieved After 6 weeks of Contamination and Treatment**			
		500mg/l	**2500mg/l**	**5000mg/l**	**Control**
pH	6.12	6.14	6.18	6.19	6.20
Temperature,^{0}C	27.70	28.00	29.00	29.15	28.85
Biochemical Oxygen Demand, mg/l	5.78	80.25*****	82.20*****	85.45*****	4.20
Dissolved Oxygen, mg/l	5.58	5.97	5.83	6.70	6.24
Chemical Oxygen Demand mg/l	7.55	98.50*****	99.45*****	99.24*****	7.86
Nitrate, mg/l	3.22	80.42*****	85.60*****	84.55*****	3.55
Phosphate, mg/l	0.61	85.48*****	82.60*****	84.25*****	0.42
Total Hydrocarbon Content mg/l	0.001	80.25*****	82.55*****	83.62*****	0.00
Total Organic Carbon, mg/l	270	85.48*****	82.60*****	84.25*****	265

*Key: * = percentage reduction*

CONCLUSION

Water lily (*Nymphea odorata)* demonstrated the potential to treat water contaminated with crude oil. It can therefore serve as agent of phytoremediation in crude oil contaminated waters. It may be useful in cleaning up the environment in case of oil spills and other related environmental problems.

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