ISSN: 2520-7687 (Print) and XXXX-XXXX (Online)
Journal of Agriculture, Food and Natural Resources
J. Agric. Food Nat. Resour., Jan-Apr 2017, 1(1): 61-64
Journal Homepage: http://www.afnrjournal.com/
http:/www.wollegajournals.com/

Original Research

Comparative Study of Influence of Selected Detergents on Selected Aquatic Plants *(Pistia stratiotes* and *Ranunculus repens)*

Mohd Arshad Siddiqqui[1]* and Narendra Kumar[2]

[1]School of Environment and Sustainable Development, Central University of Gujarat, Gandhinagar, 382030 Gujarat, India

[2]Department of Environment Science, Babasaheb Bhimrao Ambedkar (A central) University Lucknow-226025, Uttar Pradesh, India

Abstract

Indiscriminate use of detergents in cleaning adversely affects the life of aquatic organisms by polluting the water bodies with chemicals. The laundry detergent or dish detergent are commonly available as powder or concentrated solutions which are frequently used. The present study was carried out with an objective to determine effect of two detergents (sodium lauryl sulfate and sodium silicate) on two different aquatic plants *(Pistia stratiotes* and *Ranunculus repens)*. The study results indicated that lower and medium concentration of detergents does not affects normal plant growth but as the concentration increases it stunts the plant growth and lead to death of it. It could be concluded that use of detergents in water bodies should be in a controlled manner to reduce the rate of pollution and protect the aquatic organisms.

Article Information

Article History:
Received : 06-02-2017
Revised : 24-03-2017
Accepted : 08-04-2017

Keywords:
Detergents
Sodium lauryl sulphate
Sodium silicate
Hydrophytes

***Corresponding Author:**
Mohd Arshad Siddiqqui
E-mail: arshadcug68@gmail.com

INTRODUCTION

The environment is getting polluted by the technical advances developed by human for the upgradation of life system. This ultimately lead to the difficult situation of survival of biodiversity including humans themselves. The technological advancements resulted in daily use products that added the pollutants to the environment. The domestic activities that are often not considered are also a source of pollution which includes the hygienic processes using detergents. The households discharge the washed water with detergents into the drainage which ultimately reach to the aquatic resources like river, ponds and lakes. Ultimately the direct washing activity in aquatic sources in addition to the household discharge lead to the accumulation of detergents in them that result in consequences in the biosphere (Imandel *et al*., 1978).

Branislav *et al*. 2010 have reported the adverse effects of detergents on plants by his study on bean plant. They reported reduction in photosynthetic activity due to reduced chlorophyll concentration. The effect of detergents on plant are reported by many researchers. The browning and fragmentation of shoots, reduction in plant pigments and morphological changes can be correlated with increasing concentration of surfactants. The pattern of change in biochemical components like chlorophyll and protein that determines the metabolic activities of the plant are evident from the studies (Alifyah and Kavitha, 2012).

Aquatic plant *Pistia stratiotes* is found floating in different water bodies of India. The palnt propagated by seeds or stolon forms a dense mat on water surface and causes clogging in water ways. The plant commonly called as Jalkumbhi harbours mosquitoes and flowers in hot season and fruits after rain making the propagation efficient (Chadha, 1998). Creeping buttercup, *Ranunculus repens* is a perennial water plant found in water bodies across the country. They are rosettes with small green leaves over winter which otherwise are 91cm long plants with stems, leaves and showy yellow flowers (Harper, 1957). Increased use of detergents and poor sewage system in developing countries like India adds more chemicals to the water by laundry activities (Feisthauer *et al*., 2010).

In India, water bodies are getting polluted by different sources and it makes difficult to identify the contribution of single pollutant. Singh *et al*. (1990) have studied the detergents (SLS and SS) to assess their effects as pollutant in aquatic system. They have stated that it is difficult to assess the influence of SLS and SS to aquatic life in environmental conditions in India.

Hence, the present study was undertaken to assess the effect of two detergents (sodium lauryl sulfate and sodium silicate) on two different aquatic plants (Pistia stratiotes and Ranunculus repens) in the controlled environment.

MATERIALS AND METHODS

Study Area

The plants (*Pistia stratiotes* and *Ranunculus repens*) used in this study were collected from Gomati river, Lucknow, Uttar Pradesh.

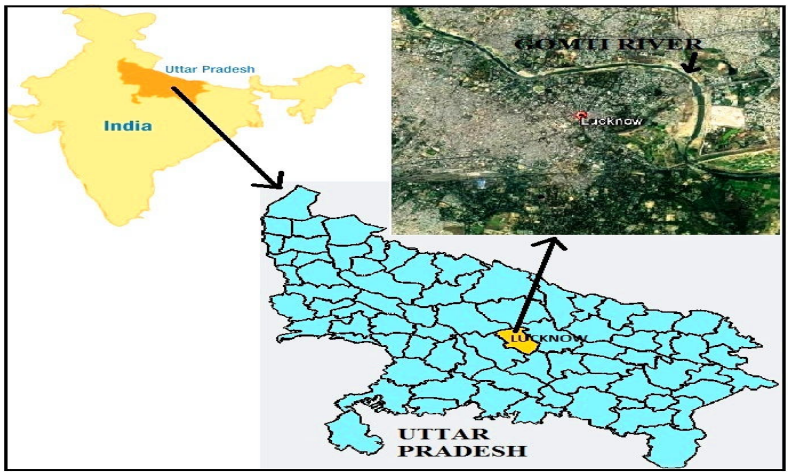

Figure 1: Study Area

The plants were brought to Department of Environment Science lab Babasaheb Bhimrao Ambedkar (A central) University, Lucknow. One surfactant, Sodium Lauryl Sulfate (SLS), and a builder, Sodium silicate (SS) were used for the toxicity tests. Three concentrations of aqueous solution of each compound were prepared in distilled water of 5 l capacity. Tubs (5 l.) were used for growing both the above plants. Five equal sized plants were placed in each tub, filled with the solution. One replicate for each concentration of the detergent were taken for our study.

Table 1: Treatment used in the study

Treatment (T)	SLS (mm)	SS (mm)
T_0 (Control)	0	0
T_1	0.5	0.5
T_2	1.0	1.0
T_3	1.5	1.5

Normal tap water served as control and. The experiment was conducted for about 4 weeks.

Morphological Changes: (such as decrease in the number of fronds and area breaking of fronds or shoots, yellowing of fronds or shoots) were visually observed.

Growth: of plants were observed in terms of decrease in the number of fronds, area breaking of fronds or shoots, yellowing of fronds or shoots besides, browning in the shoots at different concentrations.

Biochemical Components

Chlorophylls content (Arnon, 1949), total protein content (Lowry *et al*., 1951) and total carbohydrates contents (Hedge and Hofreiter, 1962) in the foliages were estimated for control and treated plant. Total carotenoids were calculated by following formula

Total carotenoids= {(4.695×O.D. 480) –0.263} Chl. a + Chl. b

RESULTS

Effect of Sodium Lauryl Sulphate on *Pistia stratiotes*

The colour of Pistia plants changed from dark green to yellowish as the concentration of sodium lauryl sulfate increased from 0.5 to 1.5 mm. There is variation in Chlorophyll “a” and total chlorophyll as the concentration of SLS varies. Chlorophyll “ b” did not exhibit any high variation. There is sequential reduction in total carotenoid content (10.4185±0.5192 mg/gm in control to 8.5033± 0.4055 in T3) of plants as the concentration of detergents increased. Similar trend is observed in total protein content (7.3944±0.5220 mg/gm in ±0.4163 control to 5.0496±0.0909 in T3) and carbohydrate content (75.8103 ±0.3354 mg/gm in control to 66.3987 in T3). The plants completely turned yellow at last and finally dried up.

Table 2: Effect of SLS on colour and biochemical parameters of Pistia stratiotes

Conc. (mm)	Colour (Visual observation)	Chlorophyll a (mg/gm)	Chlorophyll b (mg/gm)	Total Chlorophyll (mg/gm)	Total Carotenoids (mg/gm)	Total Protein (mg/gm)	Total Carbohydrates (mg/gm)
Control T_0 (0)	Dark Green	0.5404±0.0353	0.3588±0.0338	0.8670±0.0348	10.4185±0.5192	7.3944±0.5220	75.8103±0.3354
T_1 (0.5)	Green	0.5352±0.0056	0.3583±0.0359	0.8271±0.0327	9.4571±0.4352	6.5101±0.4920	75.2195±0.6124
T_2 (1.0)	Slightly Yellowish	0.4644±0.0229	0.3516±0.0444	0.7402±0.0444	9.3078±0.4121	5.7382±0.2738	69.5530±0.4229
T_3 (1.5)	Yellowish	0.4912±0.0342	0.3512±0.0340	0.6481±0.0340	8.5033±0.4055	5.0496±0.0909	66.3987±0.4163

Values are mean of three replicates (n=3±S.D)

Effect of Sodium Lauryl Sulphate on *Ranunculus repens*

In case of *Ranunculus repens* the plant is also become yellow from green and there is also decrease in chlorophyll, carotenoid, protein and carbohydrate content. There is sequential reduction in total carotenoid content (15.8630±0.1658 mg/gm in control to 13.7296±0.2324 in T3) of plants as the concentration of detergents increased. Similar trend is observed in total protein content (20.5435±0.1658 mg/gm in control to 18.4096± 0.4342 in T3) and carbohydrate content (605.5235± 0.4539 mg/gm in control to 600. 5196±0.4817 in T3).

Table 3: Effect of SLS on colour and biochemical parameters of *Ranunculus repens*

Conc. (mm)	Colour (Visual observation)	Chlorophyll a (mg/gm)	Chlorophyll b (mg/gm)	Total Chlorophyll (mg/gm)	Total Carotenoids (mg/gm)	Total Protein (mg/gm)	Total Carbohydrates (mg/gm)
Control T_0 (0)	Dark Green	0.5371±0.0248	0.5352±0.0300	1.3140±0.2891	15.8630±0.1658	20.5435±0.1658	605.5235±0.4539
T_1 (0.5)	Green	0.5486±0.0386	0.5266±0.0251	0.9737±0.0211	14.6824±0.3903	20.5255±0.4677	602.5276±0.4765
T_2 (1.0)	Slightly Yellowish	0.5373±0.0321	0.5360±0.0217	0.9467±0.0404	14.4087±0.3586	19.6271±0.3361	601.7392±0.2734
T_3 (1.5)	Yellowish	0.4332±0.0282	0.4543±0.0400	0.9437±0.0427	13.7296±0.2324	18.4096±0.4342	600. 5196±0.4817

Values are mean of three replicates (n=3±S.D)

Effect of Sodium Silicate on *Pistia stratiotes*

Growth of *Pistia stratiotes* was decreased with increasing concentration of sodium silicate from 0.5 to 1.5 mm. However it is observed that sodium silicate is less harmful for plants as compare to sodium lauryl sulfate. There is slight variation in Chlorophyll content. As there is loss of pigment, the Chlorophyll content varies (0.8437 ± 0.0394mg/gm in control to 0.8285±0.0302 inT3), total Carotenoid content varies (5.5894±0.5119 mg/gm in control to 4.6225±0.3262 in T3), total Protein content varies (7.6138±0.3406 mg/gm in control to 6.8435 ± 0.2674 in T3) and total carbohydrate content varies (77.5705±0.3617 mg/gm in control to 75.3586±0.5465 in T3).

Table 4: Effect of SS on colour and biochemical parameters of *Pistia stratiotes*

Conc. (mm)	Colour (Visual observation)	Chlorophyll a (mg/gm)	Chlorophyll b (mg/gm)	Total Chlorophyll (mg/gm)	Total Carotenoids (mg/gm)	Total Protein (mg/gm)	Total Carbohydrates (mg/gm)
Control T_0 (0)	Dark Green	0.5505±0.0457	0.4064±0.0272	0.8437±0.0394	5.5894±0.5119	7.6138±0.3406	77.5705±0.3617
T_1 (0.5)	Green	0.5605±0.0272	0.3865±0.0439	0.8489±0.0254	5.2911±0.4125	7.6335±0.3088	77.1965±0.2360
T_2 (1.0)	Slightly Yellowish	0.5607±0.0376	0.3458±0.0337	0.8650±0.0379	5.4874±0.4962	7.5748±0.2830	76.8168±0.4951
T_3 (1.5)	Yellowish	0.5529±0.0331	0.0329±0.0329	0.8285±0.0302	4.6225±0.3262	6.8435±0.2674	75.3586±0.5465

Values are mean of three replicates (n=3±S.D)

Effect of Sodium Silicate on *Ranunculus repens*

In case of *Ranunculus repens* there is same effect of sodium silicate on plants. There is also decrease in chlorophyll, carotenoid, protein and carbohydrate content. The colour of plant is changed from dark green to yellow and finally plants become dry. There is sequential reduction in total carotenoid content (15.8630 ± 0.5202 mg/gm in control to 13.7296 ± 0.2798 mg/gm in T3) of plants as the concentration of detergents increased. Similar trend is observed in total protein content (20.5435±0.5236mg/gm in control to 18.4096±0.4984 mg/gm in T3) and carbohydrate content (605.5235± 0.5921 mg/gm in control to 602.3307±3.2130 mg/gm in T3).

Table 5: Effect of SS on colour and biochemical parameters of *Ranunculus repens*

Conc. (mm)	Colour (Visual observation)	Chlorophyll a (mg/gm)	Chlorophyll b (mg/gm)	Total Chlorophyll (mg/gm)	Total Carotenoids (mg/gm)	Total Protein (mg/gm)	Total Carbohydrates (mg/gm)
Control T_0 (0)	Dark green	0.5517±0.0425	0.5536±0.0381	1.3140±0.0376	15.8630±0.5202	20.5435±0.5236	605.5235±0.5921
T_1 (0.5)	Green	0.5470±0.0438	0.5483±0.0462	0.9737±0.0408	14.6824±0.4876	20.5255±0.2777	602.5400±0.3493
T_2 (1.0)	Slightly Yellowish	0.5428±0.0510	0.5494±0.0494	0.9467±0.0481	14.4087±0.0309	19.6271±0.4942	603.5022±0.4886
T_3 (1.5)	Yellowish	0.5667±0.0406	0.4543±0.0306	0.9437±0.0445	13.7296±0.2798	18.4096±0.4984	602.3307±3.2130

Values are mean of three replicates (n=3±S.D)

DISCUSSION

Similar to present study, Puneeta Pandey and Brij Gopal (2010) have also observed that while the detergents favored the growth of plants at lower concentrations, they hampered their growth at higher concentrations. SDBS was found to be the most toxic to *Azolla pinnata, Hydrilla verticillata* and STPP the least, with SLS exhibiting intermediate levels of toxicity. Alifyah Y. Kgalwala and Kavitha (2012) have also assessed the effect of surfactant (sodium lauryl sulfate) on *Hydrilla*

verticelata. Their results showed significant effect of sodium lauryl sulphate on plant's morphology (browning of shoots, fragmentation and leaf shedding), chlorophylls and protein content. The effects on chlorophyll and protein were apparently significant at higher concentrations (4-20ppm). The plants exhibited the adverse effects of detergent after 48hrs of treatment with symptoms of brown coloration, loss of chlorophyll and etiolation. The adverse effects of most pollutants (pesticides, heavy metals and industrial wastes) on aquatic plants have been reviewed earlier (Srivastav *et al*., 1993, Heumann, 2007, Mafald S. Faria, 2007, Gabriele Alfano *et al*., 2009, Jomova *et al*., 2009) as aquatic bodies are preferred sites for the disposal of refuse, sewage and waste water from industries and domestic settlers.

In present study, the chlorophyll content was found to be reduced at higher detergent concentrations. In green leaves the chlorophyll pigment is linked chemically to proteins. SDS at lower concentrations attack different linkages wherein chlorophyll remains combined with smaller fragments of proteins while at higher concentrations was found to convert the chlorophyll into phaeophytin. According to Geeta Chawla (1989) the floating plants like *Pistia stratiote* and *Salvinia molestamitchell,* were more resistance to detergents at lower concentrations. Sodium lauryl sulphate have adverse effect on plant's morphology (browning of shoots, fragmentation and leaf shedding), chlorophyll and protein content.

The effect of the surfactant Linear alkyl benzene sulphonate, was investigated on aquatic plants by Zhao Qiang (2008). The study reported that upon exposure to these surfactants, activated oxygen species are released from mitochondria and chloroplasts. These activated oxygen species damage metabolism through oxidation of lipids, proteins and nucleic acids. Superoxide radicals are toxic byproducts of oxidative metabolism. The non-polar chain of surfactant molecules bind to various bioactive macromolecules including carbohydrate, proteins, peptides and nucleic acid thereby affect aquatic plant.

CONCLUSIONS

The present study projects the effect of detergents on aquatic plants. The detergents act as nutrient supplement at lower concentration and enhance the plant growth whereas the increasing quantity adversely affects them. Subsequent accumulation of detergents in water leads to reduction of aquatic life that leads to change in the ecosystem. Necessary control measures can alleviate these problems and help to maintain the natural environment.

Conflict of Interest

None Declared.

REFERENCES

Pandey, P. and Gopal, B. (2010). Effect of Detergents on the Growth of Two Aquatic Plants: *Azolla pinnata* and *Hydrilla verticillata*. *Environment and We International Journal of Science and Technology* 5: 107-114.

Feisthauer Kaushik, N., Sibley, P. (2010). Ecotoxicological effects of detergents on humans & aquatic organisms. *Environment and We International Journal of Science and Technology* 5: 107-114.

Kaushik, N., Gopal, B. and Chauhan, M. (2001). Eutrophication and detergents: The Canadian experience and the India scenario. In: Southey, C., Kaushik, N., Trivedy, R.K. (Eds) Detergents and the Environment. The Canadian experience and the India scenario, Tata McGraw Hill, New Delhi.

Chawla G., Virendramisra, P. and Viswanathan, N. (1989). Toxicity of Linear Alkyl Benzene Sulphonate on Some Plants, Water, Air and Soil Pollution. *Kluwer Academic Publishers* 43: 41-51.

Singh, J., Chawla G., Viswanathan, P.N (1990). Detergent Pollution and Aquatic Flora. *Journal of Scientific and Industrial Research* 49: 350-353.

Faria S.M., Nogueira, A.J.A. and Soares, A.M.V.M. (2007). The Use of Chironomus Riparius Larvae to Assess Effects of Pesticides from Rice Fields in Adjacent Freshwater Ecosystems. *Ecotoxicology and Environmental Safety* 67: 218-226.

Heuman, H.G. (1989). Effects of Heavy Metals on Growth and Ultrastructure of *Chara vulgaris*. *Protoplasma* 136: 37-48.

Jomova, K. and Mrovic, M. (2009). Effects of Heavy Metal Treatment on Molecular Changes in Root Tips of *Lupinus luteus* L. Czech. *Journal of Food Science* 27: 368-389.

Srivastav, R.K., Gupta, S.K., Nigan, K.D.P. and Vasudevan, P. (1993). Treatment of Chromium and Nickel in waste water by using aquatic plants. *Water Research* 28: 1631-1638.

Chadha, Y.R. (1998). A dictionary of Indian raw material and industrial products. New Delhi: Council of Scientific and Industrial Research. *The Wealth of India Raw Materials* 123-124.

Welsh, S.L. (1974). Anderson's flora of Alaska & adjacent parts of Canada. Brigham University Press. 724 .

Whitson, T. D., Burrill, L.C., Dewey, S.A., Cudney, D.W., Nelson, B.E., Lee, R.D., Parker, R. (2000). Weeds of the West. The Western Society of Weed Science in cooperation with the Western United States Land Grant Universities, Cooperative Extension Services. University of Wyoming. Laramie, Wyoming. 630.

Douglas, G.W. and Meidiger. D. (1999). Ranunculaceae. In: Douglas, G.W., Meidinger, D. and Pojar, J. editors, (1999). Vol 4. Decotyledons (Orobanchaceae through Rubiaceae). Illustrated flora of British Columbia. British Columbia: Ministry of Environment, Lands and Parks, Ministry of Forest; 208-244 p

Harper J.L. (1957). *Ranunculus acris* L. *The Journal of Ecology* 45: 289-342.

Imandel, K., Razeghi, N. and Samar, P. (1978). Tehran ground water pollution by detergent. *Water, Air, and Soil Pollution* 9: 119-122.

Branislav, R. Jovanić., Srdjan Bojović., Bratimir Panić., Božidar Radenković., Marijana Despotović (2010). The effect of detergent as polluting agent on the photosynthetic activity and chlorophyll content in bean leaves. *Health* 2(5): 395-399.

Alifyah Y. Kagalwala and Kavitha, K. (2012). Effects of surfactant (sodium lauryl sulphate) on *Hydrilla verticillata*. *International Journal of Life Science Biotechnologyt and Pharma Research* 1: 128.