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Research Article

ALGAL FLORA ON DEGRADING POLYTHENE WASTE

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ABSTRACT
Use of polythene has become an unavoidable entity to human life. As the consumption of polythene plastic has increased manifold, its waste management is also increasing, but still its disposal is a serious problem. A plastic is biodegradable when the degradation results from the action of naturally occurring microorganisms such as bacteria, fungi, and algae. In the present paper 10 Algal species belonging to 10 genera, 7 orders and 9 families have been enumerated from different polythene degrading sites of Kota, Rajasthan.

Keywords: *Algae, Biodegradation, Polythene*

INTRODUCTION
Millions of tones of polythene waste, including refuse sacks, carrier bags and packaging, are buried in landfill sites around the world each year. Though polythene has invariable benefits like – low production cost, lightweight, strength, relative imperviousness to gas and water, clarity, and printability are highly regarded, but the final disposal of used flexible plastic causes problems. The ever increasing use of plastics, particularly in packaging, has become a significant source of environmental pollution and problems in waste management and hazardious to wild life and human being as well, as it is usually stable and resistant to degradation. If disposed of by landfill, the plastics worsen the shortage of landfill sites. If the plastics are incinerated, they can emit poisonous gases such as dioxins. These problems motivate the public to take more care of the environment.

If allowed to escalate, without any means of control and remediation, waste production at the current rate would undoubtedly have not only adverse environmental conditions, but also social and health consequences**.** As a result, there is urgent need for methods to degrade and alleviate pollutants and waste products. Typically, strong, tough plastic films become weak and brittle, as a result of oxidative degradation.

According to Albertsson and Ranby (1975), polythene is carbon and hydrogen polymers, remarkably resistant to biological decay. Potts (1984) stated that environmental degradation by sunlight and oxygen may result in loss of tensile strength and brittleness without commensurate loss of mass, while degradation by mechanical forces may simply reduce large pieces of plastic to smaller ones. Treub (1888) suggested that microorganisms, especially algae with mucilaginous secretion of extracellular polymeric substances (EPS) are the primary colonizers of building materials, wall, rocks, etc. and play a significant role in their biodeterioration. Chaetophorales algae, diatoms and blue green algae (Phytoplankton) produce extra cellular polymeric mucilaginous substance and adhere to any type of the substratum (Fritsch 1935). According to Ford and Mitchell (1990), phytoplankton species along with other aquatic microbes are the primary colonizers that form biofilm and serve as cue for other larger organisms to colonize on the surface. Electrostatics forces, surface charges, hydrophobicity of the surface and availability of cation play an important role in forming biofilms (Bhaskar and Narayan 2005). Seneviranlne *et al.,* (2006) observed that during summer months, when the water bodies are dry, the partially decomposed / degraded polythenes exposed to the sun, split into small pieces with bacterial and algal attachment and are released into the environment. Biofilm microorganisms enhance the degradation of polythene.

Venkataraman (1972) stated that extra cellular substances of Blue green algae are able to chelate the surrounding medium leading to greater solubility and availability of nutrients.

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Present study was designed to find out the algal flora, grown at various sites of polythene disposal by using these plastics as substratum.

MATERIALS AND METHODS

Methodology

Samples (Various polythenes with blue-green algal mats) were collected from waste water of various ponds, lakes and water bodies of Kota City. These samples were inoculated and plated on solid agar medium (BG 11, MN and ASN III Media). (Geitler 1932, Desikachary 1959 and Rippka *et al.*, 1979) and sub cultured in BG11 medium. Different morphological features adopted water colour, structure and dimension of the thalli, colonies, cells, filaments and trichomes were observed with the help binocular microscope.

RESULTS

The following algal taxa were observed in the present investigation.

Amphora ovalis

Valves 44 - 46 µm long, 26 – 28 µm broad; transverse striations 10 – 13 in 10 µm (Pandey *et al.*, 1983).

Chlorella vulgaris

Cells rounded or spherical, green unicells; non-motile, round or oval, usually found solitary, sometimes in groups; Cells 3 – 7 µm in diameter (Ahmed *et al.*, 1983).

Closterium costatum

Cells elongate, without median constriction and markedly attenuated at the poles; cell wall with delicate pores; walls often brownish or yellowish brown ; Cells 313.5 µm long, 32 µm in diameter, apex 10.5 µm (Ahmed *et al.*, 1983).

Microcystis aeruginosa

Colony usually rounded; solid when young, when old, with distinct hyaline colonial mucilage, cells spherical, with gas vacuoles, 4 – 6 µm in diameter (Chadha and Pandey, 1983).

Monoraphidium contortum

Cells solitary, fusiform or contorted , sometimes cylindrical, up to 2.25 µm broad, 16 - 20 µm long, apices rounded , pointed or gradually tapering towards the poles ; cells straight , twisted or spiral, sigmoid or crescent – shaped ;cell wall uniform (Ahmed *et al.*, 1983).

Navicula cuspidata

Valves 65 – 106 µm long , 14.6 – 20 µm broad , rhombic lanceolate with actually rounded ends ; raphe thin and straight with hooked unilateral bent central pores and large terminal fissures ; axial area narrow , linear , slightly widened in the middle ; central area very small ; transverse striae 14 – 16 in 10 µm , parallel ,slightly convergent at the poles ; longitudinal striae about 25 in 10 µm (Sarode and Kamat, 1983).

Oscillatoria tenuis

Trichomes single or inter woven into flat or spongy thallus ; sheath absent ; motile , by gliding on a solid or semi solid substratum ; terminal cells distinct , pointed , bent like a sickle or , like a screw; hormogones formed by the division of the trichomes. Thallus blue green; trichomes straight, not constricted at the cross walls; trichomes 4 -7 µm broad, 2 -3 µm long; apical portion straight or slightly bent with attenuation; septa granulated (Ahmed *et al.*, 1983).

Phormidium tenue

Filaments very thin and forming a gelatinous or leathery stratum, attached by the lower side, or floating in water; sheath present , more or less firm , sometimes agglutinated or partly diffluent, thin , colorless ; trichome straight, unconstricted, apices often attenuated, straight or bent , never regularly or spirally

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coiled; capitate or noncapitate ; apical cells in many species with a calyptra. 2– 3 µm broad; cross walls ungranulated and invisible (Ahmed *et al.,* 1983).

Scendesmus acuminatus

Colony of 2 - 4 cells, arranged in single row; inner cell fusiform, crescent – shaped, or oblong; cell wall smooth , or with spines , teeth or ridges ; apices long, sharply pointed, cells 3.0 – 6.6 µm in diameter, 30 – 35 µm long (Ahmed *et al.,* 1983).

Selanestrum minutum

Colony of 4 – 16 lunate or sickle - shaped cells; cells attached by convex walls; not enclosed by gelatinous envelop; Cells mostly single, or irregularly arranged; crescent – shaped with blunt apices; 2.0 – 4.4 µm in diameter, 6.6 – 9.0 µm (Ahmed *et al.,* 1983)

DISCUSSION

Algae are abundant everywhere except in sandy desert regions and on permanent snow and ice fields and even in these in hospitable regions specialized algal flora can be found in favorable habitats. The aquatic environment comprises some seventy percent of earth surface and here algae are important as primary producers of elaborated organic materials and thus play a critical role in the economy of the seas and fresh waters. On the land they are important constituents of the flora of soil, most rocks and stone surface (Round 1973).

Algae are at times exceedingly conspicuous in fresh water habitats as lakes, ponds, pools, swamps, streams and reservoirs. In additional certain species occur in great abundance in and on soils, on logs and tree barks, on rocks, on snow and ice, in various associations with other plants as weeds, animals and in many apparently unusual places. Perhaps no other group of plants, except bacteria is able to grow in such diverse environmental conditions. The Rajasthan environment is highly suitable due to temperature ranges from 15-45º where heterogeneous algal species may be found abundantly, particularly green and blue-green algae but no details and informative work on fresh-water algal flora have been investigated (Pareek and Srivastava, 2008).

It is apparent that freshwater algae are common in occurrence and further, it has bright futures in our ever increasing and economically important feed market but no through survey and screening on fresh water algae have been accomplished. The scanty of literature on algae reflects on the meager attention drawn by algae in the state (Dadheech 1986, Darley 1982, Pareek and Srivastava 1999, Sharma *et al.,* 1999, Srivastava 1993, 1997, 1998 and 1999, Kumar 2004, Pareek *et al.,* 2004).

All these reporting of algal flora were from water bodies, fresh water lakes, salt lakes and few from aerial habitat, there was no reporting from polythenes dumping in and around water bodies (Pareek and Srivastava 2008).

Present study of algal flora of Kota region from polythene substratum reported ten species of algae, out of which Two from Bacillariophyceae, Five from Chlorophyceae and Three from Cyanophyceae. These results variably differ from the observations of Suseela and Toppo, (2006). They worked on possible biodegradation of polythene by the mean of algal biofilms. Most of the algal species were not reported in said study; possibly it is due to difference in climatic conditions of Uttar Pradesh and Rajasthan and physicochemical properties of water. Even if these species are compared with algal flora of Rajasthan, *Monoraphidium* and *Selenestrum* were not reported from Rajasthan earlier. These are new to algal flora of Rajasthan (Dadheech 1986, Darley 1982, Pareek and Srivastava 1999, Sharma *et al.,* 1999, Srivastava 1993, 1997, 1998 and 1999, Kumar 2004, Pareek *et al.,* 2004).

On the basis of present study it is difficult to state that algae can degrade the polythene yet results clearly revealed that they can serve as a substratum for algal growth.

Polythene, a xenobiotic polymer has been under large scale production since 1950s and become a global problem today. To protect this earth from this problem, a well organized studies on understanding

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biofilms, microbes and their metabolism, polythene chemistry and its degradation process definitely requires a inter disciplinary research project.

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