MANGANESE (MN) IN LICHENS GROWING ON MAGNASITE ROCKS IN INDIA

The metal accumulating ability of lichens has been widely utilized for various bioassays including air pollution and biomonitoring studies. Several studies on the metal elements accumulation from anthropogenic sources are available, while the reports on metal contents of lichens growing on the naturally mineralized rocks (Purvis and James, 1985) are meager.

In the present communication we report the concentration of manganese (Mn) in different lichen taxa growing on manganese rich rocks in the magnasite mining area, Chandak, Pithoragarh district, Uttaranchal State of India. The lichen samples were collected during September 2001. The mining area was heavily dusted and air quality was presumably poor because of the emission from the manganese smelter.

The lichen thalli were removed from the rock with snapper blade and thoroughly washed in the distilled water with constant shaking to remove the debris from the thallus surface. The samples were then oven dried to a constant weight at 80° C and 0.5g of dried samples (three replicates) were used for further analysis. The material was digested by heating at 80 ° C in the HCl and HNO_3 (3:1) mixture. The digestion was completed by adding few drops of perchloric acid. The digest was filtered through Whatman filter paper no. 42 and the filtrate is diluted to desired volume with double distilled water. The concentration of Mn is measured in Perkin-Elmer 2380 atomic absorption spectrophotometer.

Among the different lichens analysed most of the lichen taxa exhibit the range of 40 - 50 $\mu g\ g^{-1}$ Mn concentration, which is higher than the other published lichen analysis for Mn (Seaward, 1980; Lounamaa, 1965; Seaward and Bylinska, 1979; Nieboer *et al.*, 1972). *Leptogium furfuraceum* accumulated maximum amount of Mn followed by *Candelaria concolor* and *Phaeophyscia hispidula.* The concentration of Mn was low in *Dermatocarpon miniatum* and *Parmotrema praesorediosum.* The differential accumulation of heavy metals in the lichens can be attributed to their morphology, histology and physiology. The enhanced level of metals in nature can effect in morphological and histological modification of lichens and such modification especially of the rhizinae and medulla, allows for effective metal accumulation within the thallus (Goyal and Seaward, 1982). The absence of cuticle layer makes lichens prone to free intake of heavy metals ions. The thickness and texture of the thallus, rhizines, cilia and soredia are also contributed characteristically to the accumulation heavy metals. The thin homoiomerous thallus which is highly hygroscopic due to the presence of cyanobacteria makes *Leptogium furfuraceum* suitable for accumulating high amount of Mn. The thin thallus along with sorediate condition in the case of

Candelaria concolor may explain the reason for high amount of accumulated Mn. The presence of soredia provides pored or loosened cortex for easy absorption of heavy metal. *Phaephyscia hispidula* by having soredia and numerous projecting hyphae provide an increased surface area for accumulation of heavy metals. It was also observed in our earlier study (Saxena 2004) that *Phaephyscia hispidula* and *Phaephyscia orbicularis* have a natural tendency to accumulate the heavy metals in larger quantity. *Dermatocarpon miniatum* and *Parmotrema praesorediosum* on the other hand have thick and leathery thallus, which makes them resistant to heavy metal accumulation in higher concentration.

Lichens can absorb inorganic cations from the atmosphere or natural substrates on which they grow in amounts that is more than their physiological need (Lounamaa, 1956). Lichens are metal sinks capable of accumulating certain metal cations to many times to concentrations found in their associated substrates (Lawrey and Rudolph 1975; Goyal and Seaward, 1982). There is not much literature available on the ill-effects of manganese suggesting that Mn is not a dangerous metal. In the present study manganese rich magnasite rock is the major contributor of Mn, however, the dust and emission from the manganese smelter also contribute significantly. Separate experiments are needed to estimate the Mn contribution through different sources. The present study can be used as baseline information for future biomonitoring studies.

Table 1 : Mn in different lichen taxa in increasing order of concentration

Taxa	Concentration of Mn ($\mu g\ g^{-1}$)
Dermatocarpon miniatum (L.) Mann	14.33
Parmotrema praesorediosum (Nyl.) Hale	18.76
Pyxine cocoes (Swartz) Nyl.	40.27
Caloplaca decipens (Arnold) Blomb. and Forss.	49.61
Heterodermia diademata (Taylor) Awasthi	54.71
Acarospora sp.	57.06
Phaeophyscia hispidula (Ach.) Essl.	95.87
Candelaria concolor (Dicks.) B. Stein	118.66
Leptogium furfuraceum (Harm.) Sierk	160.43

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