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STUDY ON BIOCHEMICAL FUNCTIONS IN TWO MOSSES *Physcomitrium pyriforme* (*Hedw*) HAMPE. AND *Octoblepharum albidum (Hedw)* AND ESTIMATION OF SOME HEAVY METALS

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Abstract

Some outskirts and highway areas of Lucknow were surveyed and two Moss *Physcomitrium pyriforme* and *Octoblepharum albidum* (Hedw.) samples were collected from some selected areas. Samples were collected from soils and moist brick walls and heavy metals Pb, Cu, and Co analyzed for the main cause of variation in biochemical functions such as chlorophyll content, Protein and catalase. Samples collected from Garden and Monument areas were treated as Control. Samples collected from outskirts and highways areas showed higher level of heavy metals in comparison to the samples collected from Garden and Monument sites. However variable results were obtained with regard to variation in biochemical functions such as chlorophyll content, protein and catalase.

Key words**:** Biochemical functions, heavy Metals, outskirts and highways area, Mosses

Introduction

Indeed quite a large number of heavy metals are essential to plant and animal including human lives. These include to name a few, iron, manganese, copper, nickel, zinc, cobalt, chromium and molybdenum. In vitamins these metals are required in fewer quantities but when they are in high level in atmosphere they become toxic and cause toxicity in atmosphere. This is due to the basic fact that metals are not bio degradable like most organic pollutants.

Degradation of environment caused mostly due to manmade activities such as burning of wood, smelting of ores, tanning of leather, primitive methods of sewage disposal etc. Industrial revolution and urbanization also caused irreparable damage to the environment. Therefore different range of pollutants such as gases, particulates, agricultural wastes, chemicals and fertilizers, oil spills, soil wastes etc. on land and atmosphere affects the environment directly or indirectly.

Pollutants in the forms of matter appear in water or soil and eventually in human food and cause adverse effect on health. Since mosses are devoid of vascular tissues, roots and cuticle, therefore most of the nutrients and elements are acquired by them come from the

deposition of dust, gases and precipitation. For all these reasons, mosses can be profitably used as bio indicators. Linear correlations between copper, zinc and lead concentrations and bulk preparation have been studied by Andersen *et al*. (1978) for *Brachythecium salebrosu.* Hannsen *et al.* (1980) have found liner relationship between annual deposition and metal concentrations in *Hylocomium splendens*. Groet (1976) calculated metal deposition rates for the northeastern United States using *Leucabryum glaucum.* Ruhling and Tyler (1971) and Tyler (1972) estimated the degree of contamination of the whole Scandinavian territory by seven heavy metals using *Hylocomium splendens* as bio-accumulator.

Materials and method

The Lucknow is situated in the upper Gangetic plains of the country at 123 m above sea level. The climate of this region is characterized by hot and humid summers but cold and chilly winters. Summers generally start by the end of March and remains till June. The maximum and minimum temperature goes up to 31°C to 18°C respectively. Monsoon starts immediately after the summers. Annual mean rainfall is 972 mm. The distribution of rainfall is uneven and about 79% of the rainfall is received during the rainy season i.e. from 15th June to 15th September of total rain fall, about 62% is received only during two months i.e. July and August. October is the time when winter starts. This season is favorable for bryophytes and mosses (Source: Department of Tourism U.P., India).

For the estimation of Pb, Cu and Co the plant samples were oven dried for 48 hrs at 85°C. The known weight of dried plant material was well digested in a mixture (10: 1) of concentrated HNO_3 and $HClO_3$ (AOAC 1990). Residues were diluted in 25 ml. distilled water and were filtered through Whatmen Filter Paper No. 11. The concentration of heavy metals in the solution was analyzed by using Perkin-Elmer 280 Atomic Absorption Spectrophotometer. The analyses of samples were carried out in triplicates. Metal concentrations were calculated by the formula.

$$\textit{Metal concentrations} = \frac{XV}{W}$$

Where:
X = reading in ppm on Atomic Absorption Spectrophotometer
V = final volume (ml)
W = dry weight of moss in g.

Chlorophyll content was determined by the method of Petering *et al* (1940) in 1 gm of plant tissue, Pinch of $CaCO_3$ was added and paste was prepared in pastel and mortar. Thereafter 10 ml of 85 % acetone was added and filtered through Buchner funnel. The filtrate was diluted by adding 85% acetone to 25 ml. After shaking, the filtrate was transferred in test tube and Optical Density at 652 mm spectrophotometer was recorded.

For Chlorophyll calculation, following formula was used:-

$$Mg/g\ Total\ chl\ (fr.wt) = (12.25 \times a_{652} + 18.71 \times a_{652}) \frac{V}{1000} \times \frac{1}{fr.\ wt.}$$

Where

a = *absorbance at indicating wave length*

V = *volume of final extract*

fr.wt. = *weight of fresh plant material*

Protein was estimated by methods of *Lowry et al* (1951). Four reagents (A,B,C,D) were used in this procedure:

A 2% sodium carbonate in 0.1 N NaOH

B 0.5% copper sulphate in 1% sodium potassium tartrate

C Mixture of 50 ml of reagent A with 1 ml of reagent B.

D Folin -Ciocalteu's reagent diluted in 1:2 ratio

About 100 mg of plant material from treated and untreated plants were ground in 5 ml of 10% Trichloroacetic Acid (TCA) and centrifuged at 10,000 rpm for 10 min. After decanting the supernatant, pellets were washed with 5 ml of 1 N NaOH and again centrifuged in 5 ml of 1 N NaOH. 5 ml of reagent was added to final supernatant (0.5 ml) and kept for 10-15 min at room temperature. Reagent D (0.5 ml) was added at last and thoroughly mixed immediately after 15 min. The absorbency was recorded at 750 µm using bovine serum albumin (sigma) as a standard.

Catalase activity was assayed by the method of Bisht (1972) a modified method of Euler and Josephson (1927).

Results and Discussion

Lead Concentration

Area A -Garden and Monumental sites: : Samples of moss *Physcomitrium pyriforme* collected from (site no. 2) Buddha Park showed Pb concentration 148.60 $\mu g g^{-1}$ and from (site no. 1) Prince of Wales Zoological Garden showed 56.70 $\mu g g^{-1}$. Samples of moss *Octoblepharum albidum* procured from (site no. 9) Sahara City did not show any Pb content. Samples procured from (site no. 10) Chota Imambara showed Pb concentration 52.26 $\mu g g^{-1}$. Migaszewski (2002) studied the Pb concentration in moss *Hylocomium splendens*collected from three most respective habitats of Poland and found that Pb content has not changed since 1996.

Area D- Outskirts and highways:

In moss *Physcomitrium pyriforme* Highest Pb concentration has been found to be in samples collected from (site no. 3) Pharmaceutical Company, Sarojini Nagar 503.30 µgg-^{1} followed by (site no. 8) Chinhat, Faizabad Road 271.00 µgg^{-1}and (site no. 4) VIP Road 233.00 µgg^{-1}. Samples collected from (site no. 5) South City (site no. 6) Ring Road, Indira Nagar, (site no. 7) Near Canal, Jail Road, showed Pb concentration 172.00 µgg^{-}1,46.00 µgg-1 and 51.40 µgg^{-1} respectively. In moss *Octoblepharum albidum* samples collected from (site no. 16) Engineering College, Stupor Road showed highest Pb concentration 493.30 µgg^{-1}. Samples procured from (site no. 13) SGPGI, Road and (site no. 15) La-Martinier College Pb concentration ranged between 169.00 µgg-1-154.00 µgg^{-}1. Samples procured from (site no.14) Celebrity Country Club, Rae Bareli Road showed the Pb content 116.33 µgg^{-1}. Lukaskzewska et al (2002) used *Pleurozium schreberi* moss to study the level of Pb in Niepalomice forests of Poland situated 10-30 Km to the urban industrial areas and steel works which was build up to the outskirts of city in 1950. They reported that Pb concentration in moss in the Nie forest decreased with the passage of time. However, when compared with the relatively clean area in the north eastern Poland, the concentration of Pb was 4 to 6 fold higher in Nie forest.

Copper Concentration

Area A -Garden and Monumental sites: Comparatively lower Cu concentration has been found in samples of *Physcomitrium pyriforme* collected from (site no. 2) Buddha Park 48.33 µgg-^{1} and (site no. 1) Prince of Wales Zoological Garden 33.00 µgg^{-1}. Moss *Octoblepharum albidum* samples collected from (site no.10) Chota Imambara showed Cu concentration 50.66 µgg^{-1} and (site no. 9) Sahara City 24.00 µgg^{-1}. Coombes and Lepp (1974) studied the toxic effect of Cu in gemmalings of *Marchantia polymorpha* and in germinating spores of *Funaria hygrometrica* and found that Cu was more toxic in both species.

Area D- Outskirts and highways: Samples of *Physcomitrium pyriforme* procured from (site no. 3) Pharmaceutical Company, Sarojini Nagar and (site no. 7) Near Canal, Jail Road showed highest Cu concentration 200.00 µgg^{-1} and 185.00 µgg^{-1} respectively which is comparatively higher than other sites. Samples collected from (site no. 8) Chinhat, Faizabad Road and (site no. 4) VIP Road Cu concentration ranged between 129.30 µgg^{-1}-124.00 µgg^{-1} and Samples collected from (site no. 5) South City and(site no. 6) Ring Road, Indira Nagar ranged between 70.00 µgg^{-1}-40.00 µgg^{-1}. Samples of moss *Octoblepharum albidum* collected from (site no. 11) Balaganj - Kakori Road, (site no. 13) SGPGI, Road, (site no. 16) Engineering College, Sitapur Road showed higher Cu concentration 134.00 µgg^{-1},133.60 µgg^{-1} and 133.60 µgg^{-1} respectively. Samples procured from(site no. 14) Celebrity Country Club, Rae Bareli Road showed Cu concentration 118.00 µgg^{-1}. Samples collected from (site no. 12) Alambagh – Dubagga Road and (site no.15) La-Martinier College showed Cu concentration 84.33 µgg-^{1} and 28.00 µgg-^{1} respectively. Copper level in samples of moss *Hypnum cupressiforme* examined in the area of Consett (North East England), the centre of

iron and steel industry and found the high level of Cu suggesting a common origin for common metal Ellison *et al*. (1976).

Table 1.Showing Pb, Cu and Co concentration (µgg-^{1}), Chlorophyll content (mg/g fr.wt.), Protein content (mg/g fr.wt.) and Catalase Activity (µ moles H_2O_2 split / 100 mg fr. wt.) in moss *Physcomitriumpyriforme* collected from Area-A Garden and Monumental sites

Site No.	Area A - Garden and Monumental	Pb Mean + SD	Cu Mean + SD	Co Mean + SD	Chlorophyll content Mean + SD	Protein content Mean + SD	Catalase Activity *Mean + SD*
1	Prince of Wales Zoological Garden	56.70 ± 3.50	33.00 ± 1.41	39.16 ± 2.85	1.52 ± 0.04	15.70 ± 0.10	7.75 + 0.75
2	Buddha Park	148.60 ± 3.39	48.33 ± 6.18	57.66 ± 6.12	2.19 ± 0.03	14.00 ± 0.10	11.00 + 1.00

All the values are the mean of three replicates ± standard deviation.

Cobalt Concentration

Area A -Garden and Monumental sites: Cobalt Concentration in moss samples of *Physcomitrium pyriforme* taken from (site no. 2) Buddha Park and (site no. 1) Prince of Wales Zoological Garden found to be 57.66 µgg^{-1}and 39.16 µgg^{-1} respectively. Samples of moss *Octoblepharum albidum* procured from (site no. 9) Sahara City and (site no. 10) Chota Imambara showed Co concentration 29.00 µgg^{-1} and 48.33 µgg^{-1} respectively. Percy (1983) completed a regional survey of Co content in *Sphagnum magellanicum* within the maritime province and found the great accumulation of Co due to anthropogenically derived pollution in northern Ontario and southern Sweden.

Area D- Outskirts and highways: Samples of moss *Physcomitrium pyriforme* procured from (site no. 3) Pharmaceutical Company, Sarojini Nagar showed highest Co concentration 222.00 µgg-^{1} followed by (site no. 8) Chinhat, Faizabad Road 125.80 µgg-^{1} and (site no. 4) VIP Road 104.00 µgg-^{1}. Samples procured from (site no. 5) South City,(site no. 6) Ring Road, Indira Nagar and (site no. 7) Near Canal, Jail Road showed Co concentration 73.46 µgg-^{1},60.00 µgg-^{1} and 58.00 µgg-^{1} respectively. In moss *Octoblepharum albidum* highest Cobalt concentration has been shown in samples collected from (site no. 12) Alambagh – Dubagga Road 376.00 µgg-^{1}. Samples procured from (site no. 15) La-Martinier College and (site no.16) Engineering College, Sitapur Road showed Co concentration range between 97.40 µgg-1- 93.30 µgg^{-1} . Samples collected from (site no. 14) Celebrity Country Club, Rae Bareli Road and (site no. 11) Balaganj - Kakori Road Co concentration ranged between 66.00 µgg-1-56.00 µgg-1. Samples collected from (site no. 13) SGPGI, Road Co concentration found to be 13.60 µgg^{-1}. Cymerman *et al* (2002) found the content of the metal Co in aquatic bryophyte *Platyhyinidum niparioides*, *Scapariasp* and *Fontinalis antipyretica*

sampled from streams in the Erzgeting (ore mountain, eastern Germany) and found the Co concentration 140 mg/kg which is seriously exceeded background values.

Table 2.Showing Pb, Cu, and Co concentration (µgg-^{1}) Chlorophyll content (mg/g fr.wt.), Protein content (mg/g fr.wt.) and Catalase Activity (µ moles H_2O_2 split / 100 mg fr. wt.) in moss *Physcomitriumpyriforme* collected from Area D - Outskirt and Highways sites.

Site No.	Area D - Outskirt and Highways	Pb Mean + SD	Cu Mean + SD	Co Mean + SD	Chlorophyll content Mean + SD	Protein content Mean + SD	Catalase Activity *Mean + SD*
3	Pharmaceutical Company, Sarojini Nagar	503.30 ± 3.39	200.00 ± 16.32	222.00 ± 49.82	1.17 ± 0.06	10.20 ± 0.15	9.50 + 0.50
4	VIP Road	233.00 ± 2.94	124.00 ± 1.63	104.00 ± 3.26	1.06 ± 0.01	10.50 ± 0.10	8.00 + 0.50
5	South City	172.00 ± 1.63	40.00 ± 1.63	73.46 ± 2.28	1.10 ± 0.04	9.40 ± 0.10	9.00 + 0.50
6	Ring Road, Indira Nagar	46.00 ± 0.81	70.00 ± 2.82	60.00 ± 0.00	1.34 ± 0.07	10.20 ± 0.10	8.00 + 0.50
7	Near Canal, Jail Road	51.40 ± .80	185.30 ± 1.88	58.00 ± 1.63	1.66 ± 0.12	10.30 ± 0.15	5.75 + 0.25
8	Chinhat, Faizabad Road	271.00 ± 14.85	129.30 ± 4.10	125.00 ± .94	1.06 ± 0.10	8.60 ± 0.10	5.50 + 0.50

All the values are the mean of three replicates ± standard deviation.

Chlorophyll content

Area A -Garden and Monumental sites: Samples of moss *Physcomitrium pyriforme* collected from (site no.2) Buddha Park showed Chlorophyll content 2.19 mg/g fr.wt. and samples procured from (site no. 1) Prince of Wales Zoological Garden showed Chlorophyll content 1.52 mg/g fr.wt . Moss *Octoblepharum albidum* samples collected from (site no. 10) Chota Imambara showed Chlorophyll content 2.19 mg/g fr.wt and (site no. 9) Sahara City 1.99 mg/g fr.wt. Bakken (1995) investigated the difference in chlorophyll concentration in *Dicranum majus* taken away from two areas with different amounts of nitrogen deposition of genetic origin in Piceaabies forests in central Norway and found that chlorophyll concentration was higher in moss plants of southern Norway after 16 months of transplantation.

Area D- Outskirts and highways: In moss *Physcomitrium pyriforme* samples procured from (site no. 6) Ring Road, Indira Nagar and (site no. 3) Pharmaceutical Company, Sarojini Nagar chlorophyll content found to be 1.34 mg/g fr.wt. and 1.17 mg/g fr.wt respectively. Samples procured from (site no. 4) VIP Road, (site no. 5) South City and (site no. 8) Chinhat, Faizabad Road showed chlorophyll content 1.06 mg/g fr.wt, 1.10 mg/g fr.wt and 1.06 mg/g fr.wt consequently.

In moss *Octoblepharum albidum* samples procured from (site no. 14) Celebrity Country Club, Rae Bareli Road, (site no. 15) La-Martinier College and (site no. 13) SGPGI, Road chlorophyll content ranged between 1.57 mg/g fr.wt -1.55 mg/g fr. weight. Samples collected from (site no. 12) Alambagh – Dubagga Road and (site no. 16) Engineering College, Sitapur Road showed chlorophyll content 1.19 mg/g fr.wt -1.17 mg/g fr.wt. respectively. Bangtson *et al* (1982) examined that neither frequency of branching nor chlorophyll content were influenced by heavy metal pollution. Sommer (1981) examined that Cu damages chloroplasts.

Table 3. Showing Pb, Cu, and Co concentration (µgg-^{1}) Chlorophyll content (mg/g fr.wt.), Protein content (mg/g fr.wt.) and Catalase Activity (µ moles H_2O_2 split / 100 mg fr. wt.) in moss *Octoblepharumalbidum* collected from Area-A Garden and Monumental sites.

Site No.	Area A - Garden and Monumental	Pb Mean + SD	Cu Mean + SD	Co Mean + SD	Chlorophyll content Mean + SD	Protein content Mean + SD	Catalase Activity Mean + SD
9	Sahara City	ND	24.00 ± 1.63	29.00 ± 0.81	1.99 ± 0.12	16.40 ± 0.10	11.75 + 0.75
10	ChotaImambara	52.26 ± 1.31	50.66 ± 2.49	48.33 ± 8.73	2.19 ± 0.05	8.10 ± 0.10	8.00 + 1.00

All the values are the mean of three replicates ± standard deviation.

Protein content

Area A -Garden and Monumental sites: Protein content has been found to be 15.70 mg/g fr.wt and 14.00 mg/g fr.wt in the samples of *Physcomitrium pyriforme* collected from site (site no. 1) Prince of Wales Zoological Garden and (site no. 2) Buddha Park respectively. In moss *Octoblepharum albidum* samples collected from (site no. 9) Sahara City, (site no. 10) Chota Imambara showed protein content have been found to be 16.40 mg/g fr.wt and 8.10 mg/g fr.wt respectively. Schnepf and Deichgraber, (1979) studied that during the development and growth, the seta of moss sporogonium starts growing below the apical cell. In this period protein and new wall material production is required.

Area D- Outskirts and highways: Protein content in samples of *Physcomitrium pyriforme* collected from site no (site no. 4) VIP Road, (site no. 7) Near Canal, Jail Road, (site no. 3) Pharmaceutical Company, Sarojini Nagar and (site no. 6) Ring Road, Indira Nagar have been found between the range 10.50 mg/g fr.wt -10.20 mg/g fr.wt. Samples collected from (site no. 5) South City and (site no. 8) Chinhat, Faizabad Road showed protein content 9.40 mg/g fr.wt and 8.60 mg/g fr.wt respectively. In moss *Octoblepharum albidum* highest protein content has been found to be in samples collected from (site no. 16) Engineering College, Sitapur Road 10.10 mg/g fr.wt followed by (site no. 14) Celebrity Country Club, Rae Bareli Road 9.90 mg/g fr.wt and (site no. 13) SGPGI, Road 9.70 mg/g fr. weight. Samples collected from (site no. 11) Balaganj - Kakori Road, (site no. 12) Alambagh – Dubagga Road and (site no. 15) La-Martinier College protein content found to be 8.10 mg/g fr.wt,8.50 mg/g fr.wt and 8.70 mg/g fr.wt respectively. Bakken (1995) investigated in transplantation experiment, difference in protein content in *Dicranum majies* at a distance of 5 m from two areas of Piceaabies forest with different amount of atmospheric nitrogen deposition. He found four and 16 months after transplantation, the protein concentration is still higher in moss plant from southern Norway irrespective of growing site.

Table 4.Showing Pb, Cu, and Co concentration (µgg^{-1}) Chlorophyll content (mg/g fr.wt.), Protein content (mg/g fr.wt.) and Catalase Activity (µ moles H_2O_2 split / 100 mg fr. wt.) in moss *Octoblepharumalbidum* collected from Area D - Outskirt and Highways sites

Site No.	Area D - Outskirt and Highways	Pb Mean + SD	Cu Mean + SD	Co Mean + SD	Chlorophyll content Mean + SD	Protein content Mean + SD	Catalase Activity Mean + SD
11	Balaganj - Kakori Road	37.33 ± 4.49	134.00 ± 27.58	56.00 ± 11.77	1.13 ± 0.06	8.10 ± 0.05	12.00 + 0.50
12	Alambagh – Dubagga Road	ND	84.33 ± 1.64	376.00 ± 16.75	1.19 ± 0.06	8.50 ± 0.05	11.75 + 0.75
13	SGPGI, Road	169.00 ± 0.81	133.60 ± 15.79	13.60 ± 0.47	1.55 ± 0.06	9.70 ± 0.10	10.00 + 0.50
14	Celebrity Country Club, Rae Bareli Road	116.33 ± 1.69	118.00 ± 5.71	66.00 ± 8.48	2.85 ± 0.04	9.90 ± 0.05	9.50 + 0.50
15	La-Martinier College	154.00 ± 2.84	28.00 ± 0.81	97.40 ± 2.85	1.57 ± 0.04	8.70 ± 0.15	5.75 + 0.25
16	Engineering College, Sitapur Road	493.30 ± 4.71	133.60 ± 3.85	93.30 ± 4.98	1.17 ± 0.10	10.10 ± 0.10	5.50 + 0.50

All the values are the mean of three replicates ± standard deviation.

Catalase Activity

Area A -Garden and Monumental sites: Catalase activity in moss samples *Physcomitrium pyriforme* has been found to be 11.00 µ moles H_2O_2 split / 100 mg fr. wt. and 7.75 µ moles H_2O_2 split / 100 mg fr. wt. collected from (site no. 2) Buddha Park and (site no. 1) Prince of Wales Zoological Garden consequently. Moss samples of *Octoblepharum albidum* procured from (site no. 9) Sahara City and (site no. 10) Chota Imambara showed catalase activity 11.75 µ moles H_2O_2 split / 100 mg fr. wt. and 8.00 µ moles H_2O_2 split / 100 mg fr. wt. respectively. Hebant and Suire (1974) analyzed the activity of enzymes acid phosphatase, cytochrome oxidase, β - fructosidase oxalic acid oxidase, peroxidase and succinate dehydrogenase in moss *Dicranum*. Franke and Hasse (1937) estimated the catalase and oxalic acid oxidase activity in moss *Mnium*.

Area D- Outskirts and highways: Samples of moss *Physcomitrium pyriforme* collected from (site no. 3) Pharmaceutical Company, Sarojini Nagar showed higher Catalase activity 9.50 µ moles H_2O_2 split / 100 mg fr.wt followed by (site no. 5) South City 9.00 µ moles H_2O_2 split / 100 mg fr. weight. Samples collected from (site no.4) VIP Road and (site no. 6) Ring Road, Indira Nagar (Site no. 7) Near Canal, Jail Road and (site no. 8) Chinhat, Faizabad Road showed catalase activity 8.00 µ moles H_2O_2 split / 100 mg fr.wt. and 8.00 µ moles H_2O_2 split / 100 mg fr. wt., 5.75 µ moles H_2O_2 split / 100 mg fr.wt. and 5.50 µ moles H_2O_2 split / 100 mg fr. wt. respectively.

Samples of moss *Octoblepharum albidum* collected from (site no. 11) Balaganj - Kakori Road showed highest catalase activity 12.00 µ moles H_2O_2 split / 100 mg fr.wt followed by (site no. 12) Alambagh – Dubagga Road 11.75 µ moles H_2O_2 split / 100 mg fr. wt. and (site no. 13) SGPGI, Road 10.00 µ moles H_2O_2 split / 100 mg fr. weight. Samples collected from (site no. 14) Celebrity Country Club, Rae Bareli Road, (site no. 15) La-Martinier College and (site no. 16) Engineering College, Sitapur Road showed catalase activity 9.50 µ moles H_2O_2 split / 100 mg fr. wt., 5.75 µ moles H_2O_2 split / 100 mg fr.wt. and 5.50 µ moles H_2O_2 split / 100 mg fr. wt. respectively. The catalase activity has been observed by Udar and Chandra (1960) in *Plagiochasma* and *Riccia* and in other hepatices.

Conclusion

In case of moss *Octoblepharum albidum* data indicate that SGPGI, Road and Engineering College, Sitapur Road are highly contaminated with element Pb and Cu. Rae Bareli Road is also moderately contaminated for Pb and Cu. Balaganj - Kakori Road is found to be contaminated for element Cu. Alambagh – Dubagga Road is highly contaminated for the element Co. Celebrity Country Club, Rae Bareli Road is also moderately contaminated for Pb and Cu. La-Martinier College is contaminated for Pb. Alambagh – Dubagga Road is found to be polluted with Co. Whereas regarding the moss *Physcomitrium pyriforme* site Pharmaceutical Company, Sarojini Nagar is contaminated with all three elements Pb, Cu and Co. Site South City found to be polluted for Pb. Near Canal, Jail Road is contaminated with almost high value of Cu. Samples of moss *Octoblepharum albidum* taken from Outskirt and Highways sites and Garden and Monumental sites showed just about high value of catalase

activity. In case of moss *Physcomitrium pyriforme* relatively less value of catalase activity have been observed. Protien content in case of *Physcomitrium pyriforme* have been come across to be higher in comparison to moss *Octoblepharum albidum*. Both moss species did not show much difference with reference to Chlorophyll content.

It seems that there is no similar pattern of heavy metal accumulation in both moss samples but dissimilar concentration of heavy metals has been indicated at different sites. But at all traffic routes almost high level of metal concentration have been indicated. It also indicates that vehicular pollution is not the only cause of heavy metal accumulation in mosses but also some other mercantile activities being done in these areas cause contamination in moss samples.

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