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EFFECT OF ATMOSPHERIC POLLUTION ON CHLOROPHYLL AND PROTEIN CONTENTS OF SOME PLANTS GROWING IN KARACHI REGION

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The effect of air pollution caused by automobile exhausts and industries were studied on the chlorophyll and protein contents of some plants growing in Karachi. In general, pollution stress showed a decrease in the chlorophyll and protein contents in all the species examined except for *Ficus benghalensis* which showed almost equal amount of chlorophyll in control and polluted plants. Possible explanations for these changes caused by environmental pollution are discussed.

Key words: Pollution, Protein, Plants.

INTRODUCTION

In industrialized cities transportation is the most important source of atmospheric pollution contributing about 60 per cent of the total. The main sources of pollution are carbon monoxide, hydrocarbon, oxides of sulphur and nitrogen and particulate matter. These pollutants react to form a photochemical smong which is more toxic than the original emission [1]. Industries are another major source of atmospheric pullution contributing to about 16% of the total [2]. In Karachi, the Sind Industrial Trading Estate (SITE) area is the central place where textile, soap, pharmaceutical and chemical industries are located. Industries emit the most diversified pollutants, sulphur oxides being its primary pollutant.

These toxic substances adversely affect man's food supply by affecting growing plants which are particularly susceptible to pollution, These pollutants before causing visible injury to plants cause invisible injury which is due to changes in the normal metabolism of plants.

Almost no work has been carried out on the effect of phytotoxic air pollutants on plant metabolism in Pakistan. Zahoor and Qadir [3] made some studies on the changes in chlorophyll and carbohydrate contents and Ismail and Ahmed [4] studied the effect of phytotoxic air pollutants on changes in the amino acid content.

The present investigation deals with the effect of phytotoxic air pollutants on the protein and chlorophyll contents of some roadside and industrial area plants of the Karachi region.

MATERIALS AND METHODS

Fully mature and healthy leaf samples from about 3 meter height of the plant were collected in late morning during the middle of December 1982.

Leaf samples of *Nerium oleander* L., *Eucalyptus* spp, *Ficus benghalensis.* L., *F. religiosa*, L., *Alstonia scholoris*, R.Br., *Samanea saman* (Jacq.) Merrill, *Guaiacum officinale* L., *Murraya exotica* L., were collected from Gurumandir whereas *Syzyaium cumini* (L) Skeels, *Salsola baryosma* (R&S) Dandy., *F. benghalensis* L., *N. oleander* L. and *Thespesia populnea* (L) Soland ex Correa were collected from SITE and *Calotropis procera* (Willd.) R.Br., was collected from the vicinity of the National Cement Factory. For comparative studies, leaves of the same species and of approximately same physiological age were collected from the Karachi University Campus where the atmosphere is relatively less polluted. Plant samples of University Campus were used as control against the test samples.

Protein contents were determined by Lowry's method and the chlorophyll contents were determined by Maclachlam and Zaliks [6] method.

RESULTS

The chlorophyll content of roadside and industrial area plants. All plants growing along roadside and in the industrial area showed a decrease in chlorophyll content except for *F. benghalensis* which showed almost an equal amount of chlorophyll in control and polluted plants (Table 1). Among roadside plants *Ficus benghalensis*

Table 1. Effect of pollution on the chlorophyll content of some roadside and industrial area plants

S. No.	Plant	Locality	mg chl/gm fr. wt. Chlorophyll a	Chlorophyll b	Total chlorophyll
1.	*Alstonia scholaris*	Grumandir			
	Control		0.163 ± 0.002	0.182 ± 0.005	0.345 ± 0.007
	Polluted		0.142 ± 0.004	0.158 ± 0.006	0.300 ± 0.010
2.	*Calotropis procera*	National Cement			
	Control	Factory	0.068 ± 0.015	0.062 ± 0.007	0.130 ± 0.020
	Polluted		0.049 ± 0.002	0.040 ± 0.006	0.089 ± 0.008
3.	*Eucalyptus* sp.	Grumandir			
	Control		0.153 ± 0.003	0.222 ± 0.007	0.375 ± 0.009
	Polluted		0.144 ± 0.002	0.210 ± 0.001	0.354 ± 0.006
4.	*Ficus benghalensis*	– do –			
	Control		0.097 ± 0.007	0.200 ± 0.001	0.303 ± 0.008
	Polluted		0.122 ± 0.005	0.180 ± 0.006	0.302 ± 0.011
5.	*Ficus benghalensis*	S.I.T.E.			
	Control		0.145 ± 0.001	0.158 ± 0.004	0.303 ± 0.005
	Polluted		0.145 ± 0.007	0.158 ± 0.003	0.303 ± 0.010
6.	*Ficus religiosa*	Grumandir			
	Control		0.162 ± 0.001	0.220 ± 0.005	0.382 ± 0.006
	Polluted		0.115 ± 0.002	0.181 ± 0.001	0.296 ± 0.002
7.	*Guaiacum officinale*	"			
	Control		0.174 ± 0.003	0.200 ± 0.003	0.374 ± 0.005
	Polluted		0.107 ± 0.002	0.169 ± 0.005	0.276 ± 0.007
8.	*Murraya exotica*	"			
	Control		0.171 ± 0.003	0.240 ± 0.030	0.411 ± 0.033
	Polluted		0.156 ± 0.002	0.227 ± 0.001	0.383 ± 0.003
9.	*Nerium oleander*	"			
	Control		0.117 ± 0.004	0.141 ± 0.007	0.258 ± 0.010
	Polluted		0.164 ± 0.003	0.101 ± 0.003	0.197 ± 0.005
10.	*Nerium oleander*	S.I.T.E.			
	Control		0.113 ± 0.002	0.139 ± 0.021	0.252 ± 0.022
	Polluted		0.110 ± 0.005	0.110 ± 0.007	0.220 ± 0.012
11.	*Salsola baryosma*	"			
	Control		0.156 ± 0.003	0.226 ± 0.007	0.382 ± 0.009
	Polluted		0.139 ± 0.002	0.211 ± 0.002	0.350 ± 0.004
12.	*Samanea saman*	Grumandir			
	Control		0.168 ± 0.008	0.194 ± 0.005	0.362 ± 0.008
	Polluted		0.164 ± 0.005	0.136 ± 0.008	0.300 ± 0.013
13.	*Syzygium cumini*	S.I.T.E.			
	Control		0.135 ± 0.008	0.194 ± 0.008	0.329 ± 0.011
	Polluted		0.105 ± 0.007	0.169 ± 0.008	0.274 ± 0.014
14.	*Thespesia populnea*	"			
	Control		0.164 ± 0.007	0.224 ± 0.004	0.388 ± 0.011
	Polluted		0.161 ± 0.009	0.218 ± 0.000	0.379 ± 0.015

showed the least difference in chlorophyll content from its control, whereas amongst the industrial area plants *T. populnea* showed the least difference. Significant differences were observed in the case of *F. religiosa*, *S. saman* and *G. officinale* among roadside plants and in *S. cumini* and *C. procera* among industrial area plants (Table I).

Protein content of roadside and industrial area plants. A decrease in the protein content was observed in all plants growing along roadside and in industrial area (Table 2). Least differences were observed in the case of *Eucalyptus* spp, and *F. benghalensis* among roadside area plants, and in *T. populnea* and *F. benghalensis* among industrial area plants, whereas *F. religiosa* and *S. saman* among roadside plants and *C. procera* among industrial area plants showed significant decrease in protein content over control values (Table 2).

Table 2. Effect of pollution on the protein content of roadside and industrial area plants

S. No.	Plant	Locality	mg Protein/gm. fresh wt. Control	Polluted
1.	*Alstonia scholaras*	Grumandir	3.54 ± 0.02	3.05 ± 0.04
2.	*Calotropis procera*	National Cement Factory	3.91 ± 0.02	2.92 ± 0.04
3.	*Eucalyptus* sp.	Grumandir	3.80 ± 0.03	3.61 ± 0.02
4.	*Ficus benghalensis*	"	3.34 ± 0.01	3.22 ± 0.00
5.	*Ficus benghalensis*	SITE	3.34 ± 0.02	3.10 ± 0.03
6.	*Ficus religiosa*	Grumandir	3.10 ± 0.02	1.82 ± 0.03
7.	*Guaiacum officinale*	"	3.68 ± 0.08	3.00 ± 0.02
8.	*Murraya exotica*	"	3.15 ± 0.02	3.42 ± 0.00
9.	*Nerium oleander*	"	3.63 ± 0.01	3.32 ± 0.01
10.	*Nerium oleander*	SITE	3.63 ± 0.02	3.25 ± 0.00
11.	*Salsola baryosma*	"	3.71 ± 0.01	3.62 ± 0.01
12.	*Samanea saman*	Grumandir	4.40 ± 0.00	2.90 ± 0.01
13.	*Syzygium cumini*	SITE	4.61 ± 0.01	4.11 ± 0.00
14.	*Thespesia populnea*	"	4.60 ± 0.03	4.40 ± 0.03

DISCUSSION

Decrease in the chlorophyll and protein contents in roadside plants may be attributed to the air pollutant derived from automobile exhausts. These pollutants react to form a photochemical smog which appears to be more toxic than the original emission.

The SITE area is the central place where textile, soap, pharmaceutical and chemical industries are located. These industries cause air, water and soil pollution. Industrial wastes contain toxic organic solvents, cadmium, nickel, zinc, lead etc. The cement factory located in Gulshan-e-Iqbal discharges carbon monoxide, carbon dioxide, dust particles, sulphur and lime particles [7]. Changes in the chlorophyll and protein content of industrial area plant may be due to these pollutants causing air, soil and water pollution.

Reduction in chlorophyll content was observed by many workers [3, 8, 9, 10, 11]. Pollutants may affect chlorophyll molecules directly or impair synthesis of new chlorophyll by affecting the chlorophyll structure. Sometimes a pollutant affects the chloroplastic membrane and changes the shape of the chloroplast or destroys it. William *et al.* [12] observed that changes occur in stroma of chloroplasts and involve either a granulation of the stroma or the formation of fibrils or plates. Sakaki [13] observed that the breakdown of photosynthetic pigments started only after the disintegration of thylakoid membranes.

The present investigation showed that the concentration of proteins decrease in polluted plants. Decrease in protein content due to the pollutant was confirmed by many workers [10, 14, 15]. Decrease in protein could be attributed to enhanced protein degradation or the inhibition of protein synthesis without affecting amino acid synthesis. The latter would tend to increase the concentration of free amino acids. This conclusion is supported by our previous work [4]. Protein synthesis is related to RNA, and any change in RNA will affect the protein level. Many workers observed decrease in RNA and protein levels in polluted plants [9, 16].

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