Determination Of Stress And Comparison By Estimation Of Chlorophyll - a, b And Carotenoid Contents Among Plants Growing Along Mithi River, Mumbai.

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ABSTRACT: Present work deals with the extraction and estimation of chlorophyll and carotenoids in some plants growing in polluted water of Mithi River. Chlorophyll was estimated in the fresh green leaf samples using Arnon's (1949) method and the amount of chlorophyll-a, chlorophyll-b and caretenoids were estimated and tabulated. Present investigation of photosynthetic pigments extraction was performed on Ricinus communis, Tamarindus indica, Avecinia marina, Alternanthera paronchiodes, Salvadora persica, Sida acuta, Ficus raecemosa, Ficus hispida, Peltopera inerme. Each of which less or greater in quantity, contributes to the ecosystem significantly. Alternanthera paronchiodes of family Amaranthaceae showed higher values of carotenoids at Bandra's Kala nagar.

Key Words: Stress, Pollution, Chlorophyll, Carotenoid, Solvent.

INTRODUCTION

Any change in the surrounding environment may disrupt the maintenance of a steady stable state of the plant. The flexibility of normal metabolism allows the development of response to environmental changes which vary regularly and unpredictably over daily and seasonal cycles. Condition that hampers the steady state of plant metabolism through environmental modulations is called stress. Thus every deviation of a factor from its optimum does not necessarily effect in stress. Stress begins with a constraint or with highly unpredictable fluctuations imposed on regular metabolic patterns that cause bodily injury, disease, or abnormal physiology. Stress is the altered physiological condition caused by factors that have a tendency to alter the stability. Plant stress can be divided into two primary categories. Abiotic stress, physical (e.g., light, temperature) or chemical stress that the environment may impose on a plant. Biotic stress can lead to insects, disease to which a plant may be exposed during its lifetime.

Photosynthetic Pigments are the substances with very different chemical structure, they are present in the form of porphyrin pigments (chlorophyll a, b and c), carotenoids, anthocyanins and flavones. Total leaf pigment necessary for photosynthetic process includes chlorophyll-a, chlorophyll-b and carotenoids. The content of foliar pigments varies depending on species. Variation in leaf pigments (chlorophylls and carotenoids) and its relation can be due to internal factors and environmental conditions. The ratio of chlorophyll-a and chlorophyll-b in terrestrial plants has been used as an indicator of response to light shade conditions. The small proportion of chlorophyll a/b is considered as sensitive biomarker of pollution and environmental stress. Absorbance properties of pigments facilitate the qualitative and quantitative analysis of them. Carotenoids are usually represented by two(α- and β-) carotenes and five xanthophylls (lutein, zeaxanthin, violaxanthin, antheraxanthin and neoxanthin), which exhibit strong light absorption in the blue region of the spectrum. They are non-uniformly distributed in photosystems by Lichtenthaler., 1987 [5] .The changes of leaf Carotenoid content and their proportion to Chlorophyll are widely used for diagnosing the physiological state of plants during development, senescence, acclimation and adaptation to different environments and stresses. In the present investigation an attempt was made to study the stress factors on plants caused by the

surrounding enviroment or polluted water by estimating and comparing chlorophyll a, Chlorophyll b, Caretenoids and Protein contents.

The area studied is the Mithi river of Mumbai that originates from the overflow of Vihar Lake and also receives the overflows from the Powai Lake. It flows for a total of 15 km before it meets the Arabian Sea at Mahim creek flowing through residential and industrial complexes covering the area from Powai to Bandra-Kurla, and Mahim (More and Chaubal., 2016 [8].

Mithi River meets Arabian Sea at mahim bay area. This area is also nominated as bird san0ctuary where migratory birds come for nesting. It has been estimated that up to 80 % of India's urban waste ends up in its rivers. This part is also full of mangroves and other variety of plant species.

MATERIALS AND METHODS

Collection of plant samples:

In this study, Nine commonly growning plant species growing along the banks of Mithi River, Mumbai (viz. *R*icinus communis, *T*amarindus indica, *A*vecinia marina, *A*lternanthera paronchiodes, *S*alvadora persica, *S*ida acuta, *F*icus raecemosa, *F*icus hispida, *P*eltopera inerme.) were selected from five different locations for comparision and experimental purpose.

These species are mostly preferred to grow in moist condition under the shade in plane land areas. Healthy and uninfected plants species were collected at their stage of maturity and care was also taken during sampling of leaves and stem to avoid mechanical injuries. Fresh leaf samples were wash thoroughly first in tap water followed by distilled water in the laboratory, kept to dry in room temperature and analyzed for the determination of chlorophylls (Ch-a and Ch-b) and carotenoid content.

Analytical procedure:

The procedure was performed using using Arnon's (1949) method. Accurately weighted 1g of fresh plant leaf sample was taken, with 20ml of extractant (80% Acetone) mixture was centrifuge for 10 min at 5,000rpm.
The supernatant were separated and the solution mixture was analyzed for chlorophyll-a, chlorophyll-b and carotenoid content in spectrophotometer. Absorbance was measured at 663nm, 645nm, and 470nm.

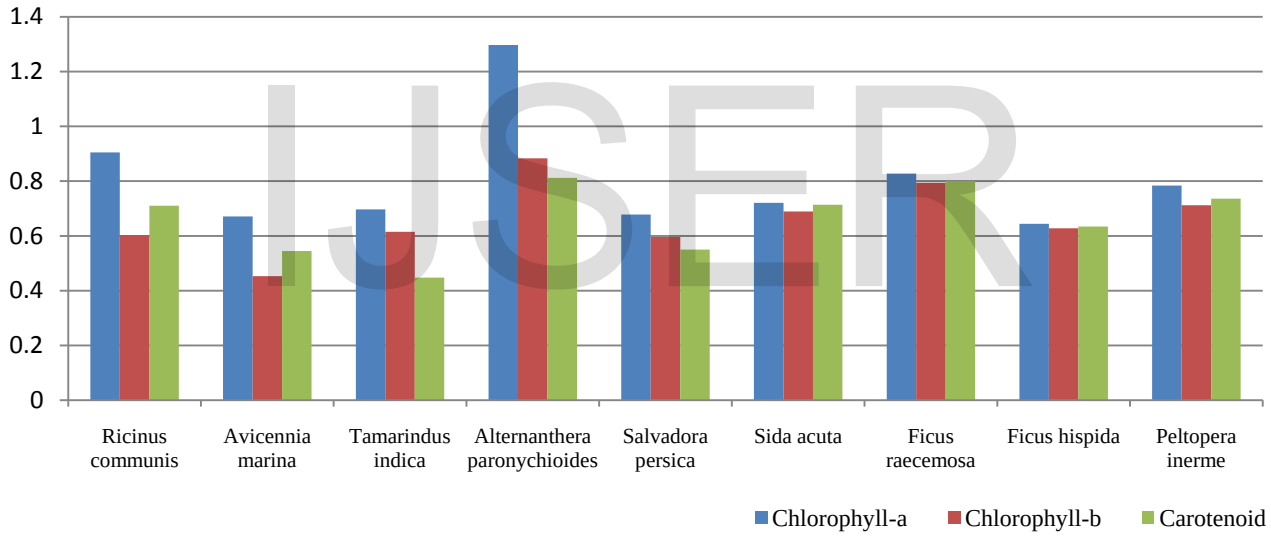
RESULTS AND DISCUSSION

Calculated value for chlorophyll and carotenoids -

Bandra Kalanagar

Test	Ricinus *c*ommunis	Avecinia *m*arina	Tamarindus *i*ndica	Alternanthera *p*aronychioides	Salvadora *p*ersica	*S*ida acuta	*F*icus raecemosa	*F*icus hispida	*P*eltopera inerme
Chlorophyll-A	0.905	0.671	0.697	1.297	0.678	0.721	0.828	0.644	0.784
Chlorophyll B	0.603	0.453	0.615	0.883	0.596	0.689	0.794	0.628	0.712
Carotenoids	0.710	0.545	0.448	0.812	0.550	0.714	0.801	0.634	0.736

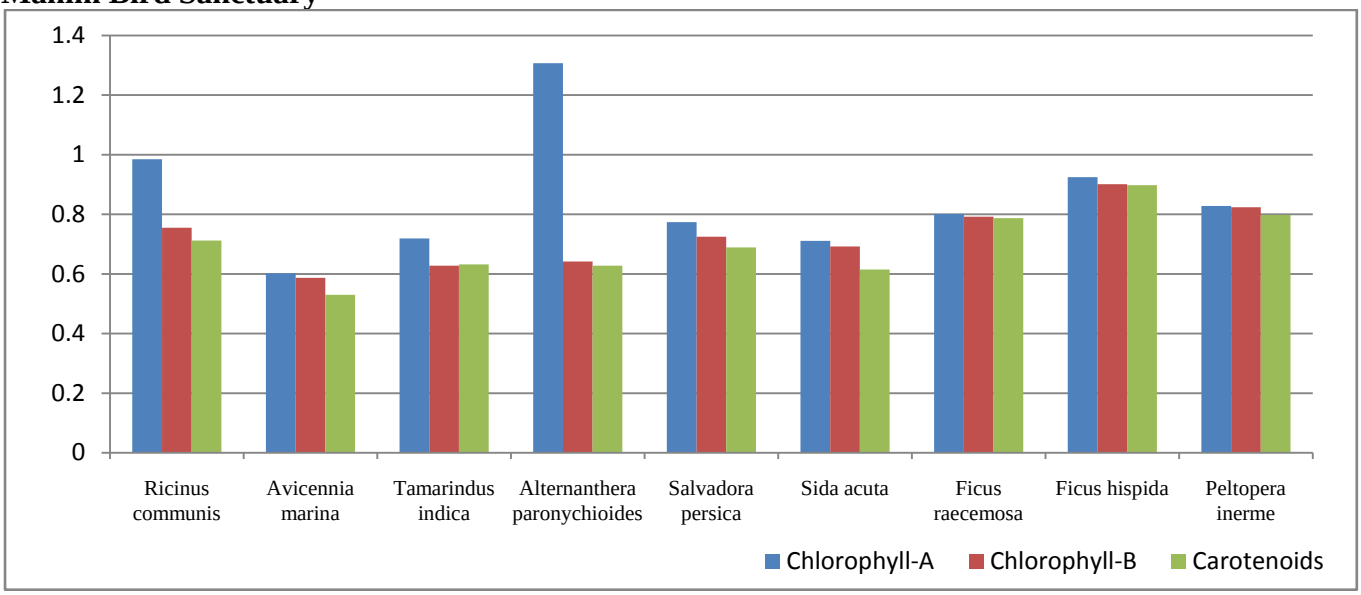
Bandra Kalanagar



Mahim Bird Sanctuary

Test	Ricinus *c*ommunis	Avicennia marina	Tamarindus *i*ndica	Alternanthera *p*aronychioides	Salvadora *p*ersica	*S*ida acuta	*F*icus raecemosa	*F*icus hispida	*P*eltopera inerme
Chlorophyll-A	0.985	0.602	0.719	1.307	0.774	0.711	0.801	0.925	0.828
Chlorophyll B	0.755	0.587	0.628	0.642	0.725	0.692	0.792	0.901	0.824
Carotenoids	0.712	0.530	0.632	0.628	0.689	0.615	0.787	0.898	0.798

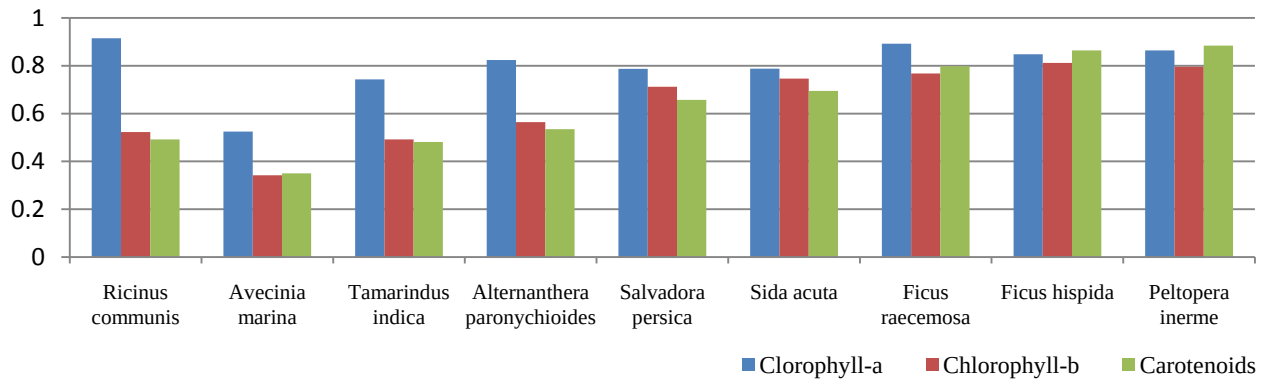
Mahim Bird Sanctuary



Shashtri Nagar

Test	Ricinus communis	Avicennia marina	Tamarindus indica	Alternanthera paronychioides	Salvadora persica	Sida acuta	Ficus raecemosa	Ficus hispida	Peltopera inerme
Chlorophyll-A	0.915	0.525	0.743	0.824	0.787	0.788	0.892	0.848	0.864
Chlorophyll B	0.523	0.342	0.492	0.564	0.712	0.746	0.768	0.812	0.796
Carotenoids	0.492	0.350	0.481	0.535	0.657	0.695	0.798	0.864	0.884

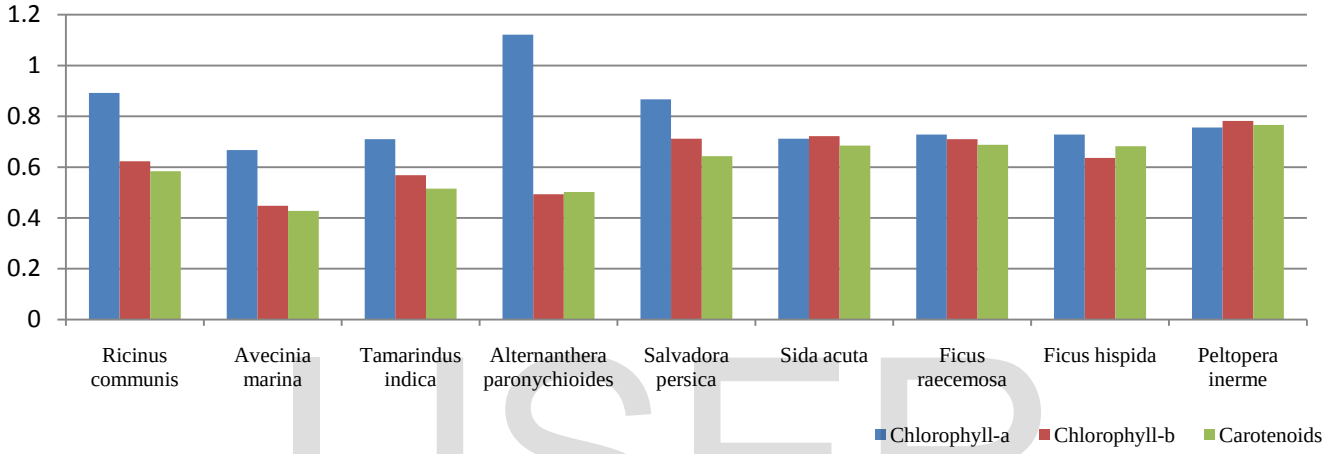
Shashtri Nagar



Kapadia Nagar

Test	Ricinus *c*ommunis	Avecinia *m*arina	Tamarindus *i*ndica	Alternanthera *p*aronychioides	Salvadora *p*ersica	*S*ida acuta	*F*icus raecemosa	*F*icus hispida	*P*eltopera inerme
Chlorophyll-A	0.892	0.667	0.710	1.121	0.867	0.712	0.728	0.728	0.756
Chlorophyll B	0.623	0.448	0.568	0.493	0.712	0.722	0.710	0.636	0.782
Carotenoids	0.584	0.428	0.515	0.502	0.643	0.685	0.688	0.682	0.766

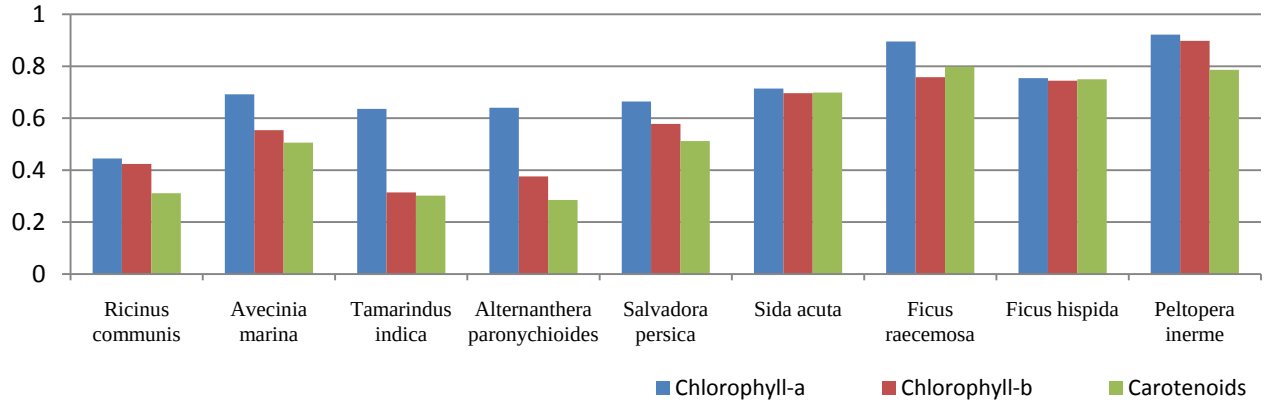
Kapadia Nagar



Kranti Nagar

Test	Ricinus *c*ommunis	Avecinia *m*arina	Tamarindus *i*ndica	Alternanthera *p*aronychioides	Salvadora *p*ersica	*S*ida acuta	*F*icus raecemosa	*F*icus hispida	*P*eltopera inerme
Chlorophyll-A	0.445	0.692	0.636	0.640	0.664	0.714	0.895	0.754	0.922
Chlorophyll B	0.424	0.554	0.314	0.376	0.578	0.696	0.758	0.744	0.898
Carotenoids	0.311	0.506	0.302	0.285	0.512	0.699	0.798	0.750	0.786

Kranti Nagar



Chlorophyll-a is recognized as the main pigment which converts light energy into chemical energy. Chlorophyll-b as accessory pigments acts indirectly in photosynthesis by transferring the light it absorbs to chlorophyll-a. Pigment content and composition in the leaves varied widely. Variation in leaf pigments (chlorophylls and carotenoids) and its relation can be due to internal factors and environmental conditions. Salihu et al., 2012 [12] while working on Ricinus communis studied that the low surface area for photosynthetic activity, are the causes of reduction in yield which supports our readings showing lower concentration of pigments at some places. The leaf diseases cause by some bacteria and fungi can also affect the yield (Darini et al 2015) supports our study showing Ricinus communis at Kalanagar in lowest concentration of chlorophyll-a at (0.103 µg/ml) and highest in *A*vecinia marina at Kranti nagar (0.692 µg/ml). Rajalakshmi and Banu ., 2014 [11] while working on estimation of chlorophyll on medicinal plants found a similar variation in repetative species from different region. The concentration of chlorophyll may vary in different region. *A*vecinia marina exhibited lowest concentration of Chlorophyll-b at Kalanagar (0.353µg/ml) and highest in *A*lternanthera paronychioides (1.307 µg/ml) at Salim-ali bird sanctuary.

Carotein content estimation is the fact that the Carotein content is much lower than the Chlorophyll content in green plants and that Caroteins exhibit absorption wavebands overlapping with Chlorophyll. Carotenoids concentration in plants ranged from lowest at (0.302 µg/ml) in Kranti Nagar to highest in Alternanthera paronychioides at Kalanagar (0.812 µg/ml).

As per More and Chaubal., 2015 [7] these sites indicated the polluted water body. From the observation chlorophyll and caretenoid content of *R*icinus communis showed highest values at Mahim Bird Sanctuary (chl-a 0.985 µg/ml , chl-b 0.755 µg/ml, carotenoid 0.712 µg/ml) and exhibit lowest concentration at Kranti nagar (chl-a 0.445 µg/ml, chl-b 0.424 µg/ml, carotenoids 0.311 µg/ml). *A*lternanthera paronychioides at Bandra Kalanagar showed the highest chlorophyll and carotenoid content than other sites amongst same plant (chl-a 1.297µg/ml, chl-b 0.883 µg/ml, carotenoid- 0.812 µg/ml). *A*vicennia marina showed higher concentration at Mahim Bird Sanctuary (chl-a 0.602 µg/ml, chl-b 0.587µg/ml, carotenoid 0.530µg/ml) *T*amarindus indica and *S*alvadora persica both exhibited highest values at salim ali bird santuary.

CONCLUSION

Results from this experiment clearly indicate that extraction of photosynthetic pigments depends on chemical nature of bio-molecules (chlorophyll-a, chlorophyll-b and carotenoids). Though slight variations persists among the experimented plants/species even for same extractant solvent which can be attribute to inherent physiological characteristics of individual species by Norman and Watkinson, 2002 [9]. Temporal and seasonal changes and local geological condition can also be the reason for variations in pigment concentrations in plants, therefore further study in this context is recommended.

Mahim's famous nominated bird sanctuary area of study has shown maximum number of photosynthetic pigments (chlorophyll-a, chlorophyll-b, carotenoids) on an average amongst the other plants studied at different locations. Thus the Salim-ali bird sanctuary area of study fairs well in harbouring healthy environment and healthy plants when compared to other study areas of interest.

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