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Activity of enzyme catalase in some species of *Ficus*

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Abstract

Plants are necessary for all life on Earth. As a critical part of the ecosystem, plants provide oxygen for organisms to survive. They are able to reduce the problem of pollution, by using carbon dioxide and releasing oxygen, an essential gas for all aerobic organisms. Also, there are many other processes that make them to survive in adverse conditions. One of such process is the role of enzyme in plant. In the present investigation activity of catalase enzyme was studied. Catalase an antioxidative enzyme minimizes cellular oxidative damage during stress condition in plants. In the present investigation activity of enzyme catalase was studied in *Ficus religiosa, Ficus bengalensis and Ficus glomerata* growing at various cross-roads of Ahmedabad city. From the study it was found that catalase activity was less in the leaves of plant growing in polluted area compared to those growing in low polluted area.

INTRODUCTION

In the days before the proliferation of large cities and industry, natures own system kept the air fairly clean. Wind mixed and dispersed the gases, rain washed the dust and other easily dissolved substances to the ground and plants absorbed carbon dioxide and replaced it with oxygen. With increasing urbanization and industrialization, humans started to release more wastes into the atmosphere than nature could cope with. Since then, more pollution has been added to the air by industrial, commercial and domestic sources. As these sources are usually found in major cities, the gases that are produced are usually concentrated in the air around them and cause the adverse effects of air pollution (E.g. London smog; 1952). When these concentrated gases exceed safe limits than we have a pollution problem.

Plants can improve the air quality in some extent; air pollution may adversely influence the plant life. Air pollutants such as ozone may enter into plant tissues via stomata and elevate the level of reactive oxygen species (ROS) causing serious damage to the DNA, proteins and lipids [1]. It is well known that plant cells have several antioxidative defence mechanisms such as tocopherol, carotenoids, glutathione and glutathione reductase enzymes, superoxide dismutase, catalase, ascorbate peroxidase, polyphenol oxidase and particularly peroxidase to protect plants against these oxidative stressors [2] [3] [4] [5]. However, the activation of antioxidative defence mechanisms requires a high consumption of energy which may consequently inhibit the plants growth.

The plant antioxidant system consists of protective enzymes such as superoxide dismutase (SOD), catalase (CAT), and peroxidases (PODs), as well as of low-molecular weight antioxidants such as ascorbate, glutathione, a-tocopherol, and carotenoids [6].

In this study, the air pollution effects on the activity of antioxidant enzymes were investigated in *Ficus religiosa, Ficus bengalensis and Ficus glomerata* plants in Ahmedabad. Plant leave samples were collected from various selected sampling sites simultaneously. The activity of different plant enzymes including catalase were investigated using spectrophotometric methods. A number of plant injury symptoms induced by urban air pollution was investigated in selected popular plant clones.

MATERIALS AND METHOD

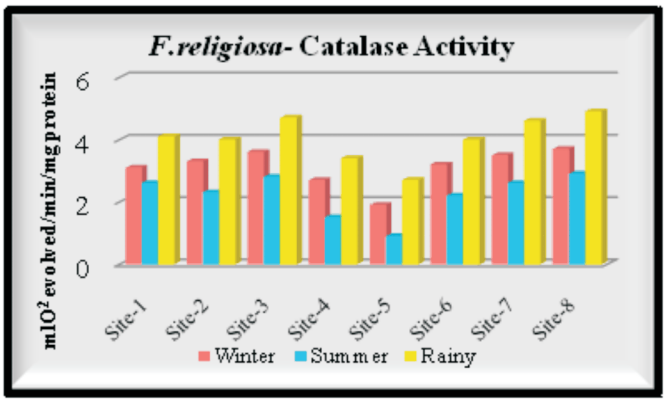
Site Selection: Ahmedabad, a mega city of Gujarat, is continuously losing its grace and beauty under the growing pressure of densification of activities [7]. The air is being continuously polluted in urban areas because of heavy traffic, industry, domestic fuel combustion; coal based thermal power plants and various agricultural activities from the adjoining areas. Seven different cross-roads of the city were selected for the study and were compared with control.

Parameters and sampling frequency: At the height of two to three meters, fully expanded mature leaves were collected from each plant in the polythene bags and transported to the laboratory. The leaf samples were collected on seasonal basis and this frequency was strictly maintained throughout the year (November 2009 to October 2010).

Investigations of catalase activity were carried out in all the three plants (*Ficus religiosa, Ficus benghalensis* and *Ficus glomerata)*.

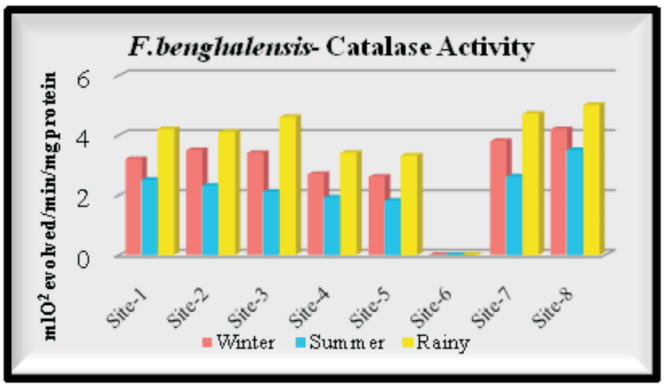
Method for enzyme extraction: 1gm plant material was grinded in 10ml phosphate buffer. The extract was centrifuge at 10,000 rpm for 15minutes at 4^0C. Supernatant was used to study enzyme activity.

Measurement of Catalase activity: Catalase activity was performed using the method of Chance and Maehly (1955)[8]. Reaction, mixture was prepared by mixing 3ml of phosphate buffer (0.1M, pH= 6.8), 1ml 0.1M H_2O_2 and 1ml enzyme aliquot. It was incubated at room temperature for 1min. Further reaction was stopped by addition of 10ml 20% H_2SO_4. This mixture was titrated against 0.01N $KMnO_4$ to estimate the residual H_2O_2 until a faint pink colour persisted for at least 15secs. This enzyme activity was expressed as amount of enzyme break down by H_2O_2/min/gm plant material.



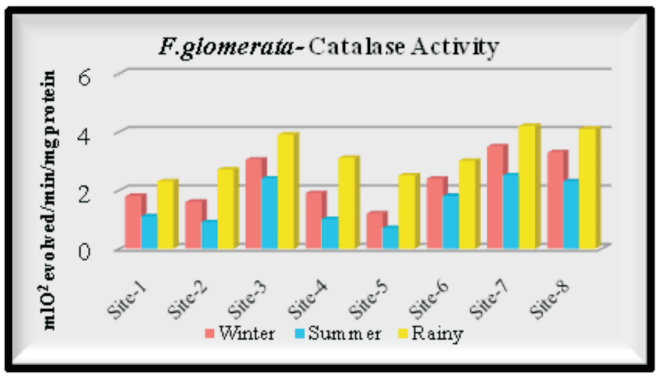
Site1-Powerhouse Site2-Paldi Site3- Laldarwaja Site4-STbusstand Site5-Naroda Site6-Railway station Site7- Residential area Site8-Control.

Fig: a) Catalase activity in the leaves of *F. religiosa*



Site1-Powerhouse Site2-Paldi Site3- Laldarwaja Site4-STbusstand Site5-Naroda Site6-Railway station Site7- Residential area Site8-Control.

Fig: b) Catalase activity in the leaves of *F.benghalensis*



Site1-Powerhouse Site2-Paldi Site3- Laldarwaja Site4-STbusstand Site5-Naroda Site6-Railway station Site7- Residential area Site8-Control.

Fig: c) Catalase activity in the leaves of *F.glomerata*

RESULT

F. religiosa

Catalase activity in the leaves of *F. religiosa* growing at all the sites has been shown in fig (a). As compared to the control area and low polluted area, at all the sites catalase activity was found less. Catalase activity was highest at all the sites in rainy season and lowest in summer season. Maximum catalase activity was found at site- 8(Control, 4.9) and minimum at site-5 (Naroda, 0.9).

F. benghalensis

Catalase activity in the leaves of *F. benghalensis* growing at all the sites has been shown in fig (b). As compared to the control area and low polluted area, at all the sites catalase activity was found less. Like in *f. religiosa* here also catalase activity was highest at all the sites in rainy season and lowest in summer season. Maximum catalase activity was found at site- 8(Control, 5.0) and minimum at site-5 (Naroda, 1.8). At site-6 plant was not available.

F. glomerata

Catalase activity in the leaves of *F. glomerata* growing at all the sites has been shown in fig (c). As compared to the control area and low polluted area, at all the sites catalase activity was found less. Catalase activity was highest at all the sites in rainy season and lowest in summer season. Maximum catalase activity was found at site- 7(Residential area, 4.2) and minimum at site-5 (Naroda, 0.7).

DISCUSSION

In order to minimize cellular oxidative damage, plants produce antioxidative enzymes such as superoxide dismutase (SOD), catalases (CAT), peroxidases (POD), ascorbate peroxidase (APOD), glutathione peroxidase (GPOD) and glutathione reductase (GR) [9]. In the present study activity of catalase was done in the plants growing in polluted and low polluted sites. From the fig (a-c) it is evident that catalase activity was significantly less in all the three species of *Ficus* growing in polluted sites.

Air pollution consists of various pollutants such as SO_2, NO_2, and CO_2 etc. Such environmental pollutants create oxidative stress in plants which causes injury in them. Plant responds to this by triggering defense mechanism. Plant cells have antioxidative defense mechanisms to protect plant against oxidative stress created by environmental pollutants. Catalase is an antioxidative enzyme, belongs to the category of antioxidative defense mechanism whose function is to protect plants against oxidative stress. In the present investigation catalase activity is found to be reduced in polluted site compare to control it may be because catalase is not a stable enzyme and it is susceptible to photoinhibition and degradation [10] [11].It has been found that exposure to elevated CO_2 significantly reduces the activity of catalase in spruce and tobacco [12] [13]. The air pollutants may alter the catabolic activities either damaging the tissue or by disturbing the metabolic pool in the leaves. Less catalase activity was observed in the SO_2 exposed plants may be due to catabolic disturbance in the cell [14]. A decrease catalase activity in SO_2 exposed *Vicia faba, Penicum miliaceum* and *Oryza sativa was reported by* [15]. Decreased in catalase activity due to SO_2 exposure in the seeds has been reported by [16] and [17] and in the leaves by [15] [18][19].

CONCLUSION

Catalase activity was less in all the plants under study growing in high polluted area compared to those growing in low polluted area. Similar result was observed by other researcher's also [20] [21] [22]. They associated decrease catalase activity with increase peroxidase activity. Ghorbanli *et al* [23] in Nerium oleander and Robinia pseudo acacia in Tehran city, observed increased activity of catalase in both the plant samples. According to some authors, one and the same enzyme may have different level of resistance to stressors in different species leading to decrease or increase of enzymatic activity [24].

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