Effect of aqueous sulphur dioxide on the biochemical and antioxidant properties of *Malva sylvestris*

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SUMMARY

Leaf discs of *Malva sylvestris* were treated with different concentrations of aqueous sulphur dioxide (10-1000 ppm) under illumination for 4 hours to study changes in various biochemical and antioxidative properties of the plant. A concentration dependent decrease in the chlorophyll, pheophytin and carotenoid content was observed. Similar results were obtained for proteins. The amino acids, however, increased in response to increasing sulphur dioxide concentration. The exposed plants showed a concentration dependent decrease in starch as well as free sugars. A decrease in the level of total phenolics was also observed with increasing sulphur dioxide concentrations. A concentration dependent increase in the activity of superoxide dismutase, catalase, ascorbate peroxidase, glutathione reductase, glutathione-*S*-transferase and glutathione peroxidase was observed. The lipid peroxidation increased significantly in response to increasing sulphur dioxide concentration.

Key words : Aqueous sulphur dioxide, Chlorophyll, proteins, Sugars, *Malva sylvestris*, Enzymes, Pheophytion.

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Growth and development of plants is affected by various environmental factors including the pollutants. Due to the recent industrial revolution and developments in the field of science and technology, a huge quantity of wastes in the form of industrial and agricultural effluents, sewage and domestic wastes, residues of pesticides, herbicides, insecticides, fertilizers, detergents and heavy metals, various toxic gases, flash etc. are regularly thrown into rivers, ponds, air, open places ultimately causing environmental pollution. These environmental problems have become so severe that various flora and fauna are in danger. Among the gaseous pollutants, sulphur dioxide is considered to be the most wide spread phototoxic air pollutant altering plant growth and metabolism.

Sulphur dioxide toxicity on vegetation has been well reviewed in terms of foliar injury and physiological and biochemical alterations (Khan and Khan,1993; Javeed *et al*., 1998; Masood *et al*., 2001, Agarwal and Deepak, 2003; Amin *et al*., 2007; Dar *et al*., 2008). Sulphur dioxide penetrates the leaves principally through the stomata and then diffuses through the cell membrane into the cytoplasm. In the cytoplasm, it is hydrated to form sulphurous acid which is converted to bisulfite and sulfite (Cotton and Wilkinson, 1980). These anions are highly phytotoxic. They are detoxified by oxidation to sulfate and then incorporated into the normal sulphur metabolic system (Huber *et al*., 1987; Takahama *et al*., 1992). In excess of a certain level, sulphur dioxide exerts its damaging effects. The damage produced by sulphur dioxide to plants includes membrane damage, chlorophyll destruction, interference with the activity of enzymes, plasmolysis, genetic material destruction and retarded growth and development (Ventaketashwar, 1992; Lee *et al*., 1997; Anuradha *et al*., 1999; Amin *et al*., 2007; Dar *et al*., 2008). However, the sequence leading to such disability is poorly understood. The present study has been used to determine changes in various biochemical and antioxidative properties which lead to tissue injury.

MATERIALS AND METHODS

Generation of aqueous sulphur dioxide:

Sulphur dioxide was generated by reducing hot concentrated sulphuric acid with copper turnings and estimated according to West and Gaeke (1956).

$$Cu + 2H_2SO_4 \rightarrow CuSO_4 + 2\,H_2O + SO_2$$

Exposure of leaf discs to aqueous sulphur dioxide:

Malva Sylvestris was purchased from local market and discs of 1 cm diameter each were cut from healthy leaves using a stainless steel cork borer. Leaf discs were treated with 10, 100 and 1000 ppm of aqueous sulphur dioxide for four hours in Petri dishes (15 x 20