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EFFECTS OF CARBON DIOXIDE AND BISULPHITE SOLUTION ON SPECIES COMPOSITION, DENSITY AND CELLS CHARACTERISTICS OF TERRESTRIAL MICROALGAE

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ABSTRACT

Microalgae are known to have high tolerance to environmental changes particularly of atmospheric pollutants. The effects of elevated CO_2 on the density and chlorophyll-a content of the most dominant terrestrial microalgae (*Chlorococcum* sp.) has been investigated in the laboratory. The treatments involved were CO_2 concentration at 450 ppm, 750 ppm and control. The experiment was conducted in a CO_2 growth chamber. The effects of elevated bisulphite (HSO_3^-) on the density and chlorophyll-a content of the *Chlorococcum* sp. was investigated by exposing the microalgae to HSO_3^- solutions (0 mM to 1.2 mM). HSO_3^- solution is the closest representative to SO_2 in the atmosphere. The density of microalgae exposed to the pollutant was measured on a weekly basis until week 12. In addition to that, chlorophyll-a content was measured at the beginning and at the end of the experiment using a spectrophotometer. The results showed that *Chlorococcum* sp. was the most dominant species in both polluted and less polluted areas followed with *Trebouxia* sp. *and Trentepohlia* sp. 1. Average microalgal density in polluted area ($954.4 \pm 27.6 \times 10^3$ cells/cm^2) is significantly higher as compared to the less polluted area ($122.1 \pm 9.4 \times 10^3$ cells/cm^2) ($p < 0.05$). *Chlorococcum* sp. treated with elevated CO_2 showed that higher concentration resulted in higher microalgal density and chlorophyll-a content. CO_2 concentration at 750 ppm demonstrated the highest microalgal density ($729.1 \pm 21.3 \times 10^4$ cells/mL) and the chlorophyll-a content (7.7 ± 0.004 µg/mL). *Chlorococcum* sp. exposed to HSO_3^- showed that higher concentration resulted in higher inhibition in microalgal density and chlorophyll-a content where 1.2mM bisulphite recorded the lowest microalgal density ($77.7 \pm 0.1 \times 10^4$ cells/mL) and chlorophyll-a content (0.4 ± 0.005 µg/mL) as compared to other HSO_3^- concentrations. In conclusion, this study concluded that the growth of terrestrial microalgae was triggered by high CO_2 content but inhibited by high HSO_3^- content.

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CHAPTER ONE
INTRODUCTION

1.1 Research Background

Air pollution caused the greatest damage to forest ecosystems as compared to other types of pollutions (Dominick *et al.,* 2012). Thus, government, environmental agencies, industries as well as the public is concerned on air pollution and its impact on the community and ecosystem. The atmospheric pollution varies temporally and is related to the climate change. Biomonitoring approach has been integrated with the pollution monitoring for decades as it does allow detection of extreme events that is not recorded by non-continuous pollution monitoring (Nguyen-Viet *et al.,* 2004). Bioindicators are living organisms include the animals and plants which used to monitor or screen the health status of environment that typically disrupt by anthropogenic activities (Holt & Miller, 2011).

Any physiological, chemical or behavioural changes of bioindicators differ between organisms and can reflect the severity level of pollution in an ecosystem (Parmar, Rawtani & Agrawal, 2016). Bioindicators can be classified into two groups; sensitive bioindicators and tolerant bioindicators (Weis *et al.*, 2017). Sensitive bioindicators refer to organisms which strongly affected and can be killed by the presence of high concentrations of pollutants (Firmiano *et al.*, 2017). Sensitive bioindicators give an early diagnostic for the presence of pollutants or contaminants which may cause the damage to the ecosystem (Hamza-Chaffai, 2014). Meanwhile, tolerant bioindicators refer to organisms which can resist and show no or little effects when exposed to high concentrations of pollutants or contaminants (Firmiano *et al.*, 2017). Tolerant bioindicators typically able to accumulate more nutrients and grow abundantly which directly reflect the health status of the environment to be poor (Bharti, Trivedi & Kumar, 2017).

Microalgae are known to be one of the biological organisms that have been utilised as biological indicators (Montoya-moreno & Aguirre-ramírez, 2013). Since microalgae have short life cycle and are highly in contact with the surrounding environment, microalgae are very suitable to study stress physiology. The reactions showed by microalgae towards pollutants in terms of diversity and abundance suggests