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The Fluorometric Response of Cyanobateria To Short Exposure of Heavy Metal

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ABSTRACT

This study is focused on the response of cyanobacteria Anabaena torulosa to a short exposure to copper. Measurement was based on the differential of the fluorescence signal of the organism before and after the exposure to copper, with excitation and emission set at 526 nm and 648 nm respectively. To optimize the yield of fluorescence signal, the day-7 culture of cell suspension was used with the density of OD_{700nm}= 0.45 A, with short exposure time of 8 minutes to Cu. Tests on different concentration of Cu showed the cyanobacteria fluorescence yields formed a linear range from 1 – 10 µg/L. The cyanobacteria could be a good candidate for biosensor for producing signals under a short exposure to low concentration of Cu.

Key words: Cyanobacteria, fluorometric response, heavy metal, short exposure time.

Introduction

As a tool designed for rapid assessment of the presence of toxics, the response time in developing a biosensor is always a challenge. A few cyanobacteria have been reported as a potential candidate to be used in biosensor [3,12,25,33]. However, the response of cyanobacteria to short period of exposure to heavy metals is yet to study. The objective of this study is to determine the fluorometric response of cyanobacteria in suspension to Cu in a short period of time. The study is very important to identify the possibility of the cyanobacteria *Anabaena torulosa* to be used in biosensor.

Cyanobacteria or blue-green algae, are prokaryotes with high diversity and adapted to many habitats, which has existed for millions of years [32,15]. Cyanobacteria are chlorophyll containing photosynthetic organisms with the ability to produce oxygen [2]. The chlorophylls in cyanobacteria serve as the receivers to the photons from the sun [30]. Most of the potential energy received is diffused through the conversion to heat, while some of the potential energy cascade down through a electron transport chain, which ends up with the production of NADPH. A small amount of the potential energy is channeled through the emission of fluorescence.

The chlorophyll fluorescence occurs when an excited electron returns to its resting state through photon emission [15]. According to Planck equation, the photon emitted through fluorescence with lower energy has longer wavelength compared to the wavelength of the photon absorbed. The *in vivo* studies conducted by Evan and Brown [7] and Krause and Weis [13] showed the chlorophyll fluorescence is contributed significantly by PSII, where the $P680^+$ is reduced to P680. In biological system, chlorophyll fluorescence is low.

The presence of heavy metals are reported to inhibit the photosynthesis by the binding to the oxidation sites and the reduction of PSII [1,4,14]. Yatsenko [34] stated that the heavy metals stop photosynthesis by inhibiting the –SH containing proteins. *In vitro* experiment carried out by Kimimura and Katoh [11] confirmed that the heavy metals are able to inhibit plastocyanin, which appears to be an important electron transporter in photosystems. As the presence of heavy metals inhibits the electron transport chain in photosynthesis, hence increases the fluorescence emission as an alternative channel to drain the energy collected from the sun.

In this study, the Cu was selected as the representative of heavy metals. The heavy metal is less toxic to the plants, as Cu is required in small quantity for the plants in the synthesis of metaloproteins [5]. The response of the *A. torulosa* to Cu could serve as a reference to other heavy metals, which are more toxic to cyanobacteria.

Material and Methods

The Culture and the Determination of the Cell Growth:

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