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A comparative account of Green algae growth influenced by Audible sound

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Abstract

It has been observed that the audible sound plays a positive impact to enhance the algal growth. In this study using audible sound on green algae we could easily increased their cell turbidity and lengthen the stationary phase duration. The growth of algae was increased up to 53.44% such increment was solely for the stimulation of sound energy on *Clorococcum* sp. and *Cladophora* sp.

Key words: Green algae, algal growth, Audible sound.

Sound is a vibration which propagates in the form of a wave through a medium (liquid as water, a gas as air or a solid material) and transmitted in longitudinal and transversal (only for solid) forms by oscillating the particles (along with or angular direction). Sounds frequency between 20Hz to 20000 Hz is considered as audible sounds. Based on frequency (Hz), intensity (dB) and timber, sounds are divided into 4 groups-

20 to 200Hz, low frequency bands,

200Hz to 1 KHz, medium low frequency bands,

1 to 5 KHz, medium high frequency bands,

5 to 20 KHz, high frequency bands[11].

In plant physiology, sounds have great impact for controlling the growth rate, defensive mechanisms against pests like caterpillar and stress conditions and pollination by pollinators including butterflies, bees. Different plant organs can produce and response with different sound frequencies at different growth stages under different situations[2]. Plants can produce both very low frequencies (50-120 Hz) and ultrasonic sound frequency (20-100 KHz)[5]. Depends on different plants species like algae, bryophyte, angiosperms, fungi, they required different frequencies of sounds to grow.

Here, we studied about the effects of sounds in various algae (micro and macro) for their important role in ecosystem (CO_2 & nutrient cycle and O_2 producers) and food economy. Algae, heterogeneous photosynthetic living organisms, generally found in aquatic environment, had two major groups- macro

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algae (seaweed) and microalgae (unicellular). In 2018, Freeman *et al*.[4] in paper "photosynthesis by marine algae produces sound, contributing to the daytime soundscape on coral reefs" told that seaweed can produce 2 to 20 KHz sound bands under natural conditions[4]. The source of this sound is a spherical shaped oxygen bubbles, released from algal filaments. Cellular level of algal cell changed by the transmission of this sound and they start to response as stress conditions such as hydrostatic pressure, changes of plasma-membrane tension etc. Larsen and Gilbert,[7] developed a special music, named "microbial bebop" by using the microbial genes (DNA) sequences to highlight the relationships of microbial communities with different ecological aspects[7]. They used beat, pitch, harmony and duration, according to bebop jazz principles. It is the combination of 4 different music algorithms- "Blue for Elle", "Bloom", "Far and Wide" and "Fifty Degrees North, Four Degrees West". Christwardana and Hadiyanto used "Blue for Elle" and "Far and Wide" to study the growth and productivity of *Haematococcus pluvialis*[3]. Jiang *et al*.,[6] examined the propagation rate of Chlorella pyrenoidosa, using several sound waves and stated that 0.4 KHz sound frequcency improved the growth rate about 12-30% more than controlling condition[6]. Under different wave frequencies algae also increased the synthesis of triacylglycerols and lipidic components. So, it is considered as sound is useful to promote the growth and productivity of algae.

Fresh algal sample (*Chlorococcum* sp. & *Cladophora* sp.), algal culture media BG11, Led light 2500Lux, temperature ±25°C, Android phone with sound monitoring applications.

Green microalgae, *Chlorococcum* sp. have thin mucilage bounded spherical or slightly oblong, unicellular cells and belong to the family Chlorococcaceae. They are found as small cluster and colonial form in both fresh and marine water[12]. Branched filamentous yellowish green algae, *Cladophora* sp. belong to the order Cladophorales and family Cladophoraceae[8,9,10] and grow in huge masses on fresh water when phosphorus and nitrogen content[1] are increased but sometimes also found in marine. They are the main causing factor for seasonal algal bloom and they imprinted over native aquatic communities.

Maximum algal species, especially microalgae grows very fast than any kind of terrestrial plants. The algal growth rate can change depending on the environmental or other physical conditions. By the measurement was followed- Algal growth measurement by optical density (OD): Algal growth rate measured through spectrophotometric absorbance, here optical density (OD) was taken in 680nm after three days interval. Algal growth measurement by fresh weight method: By the weighing biomass of algal sample growth rate also calculated. This method applied on filamentous alga. Here measured the initial weight of sample which was cultured in algal culture media BG11, 2gms algal inoculum was added. The mass of experimental set up was 105 gms in total. Then the mass of entire set up were recorded at 3 days of interval and the growth of algae in terms of fresh biomass was calculated.

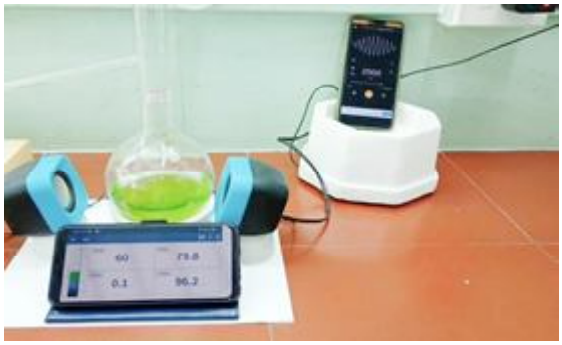

Fig. Experimental set up of culture with sound monitoring devices.

Results Analysis

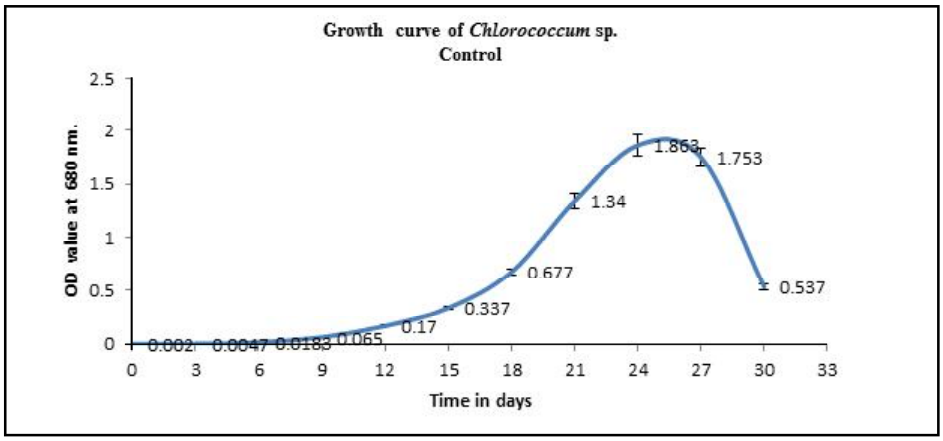

Fig. 1. Growth curve of *Chlorococcum* sp. control culture.

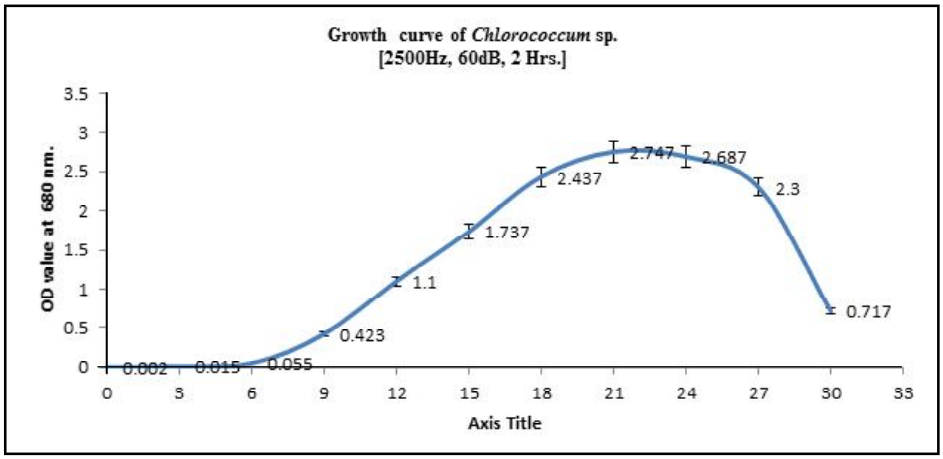

Fig. 2. Growth curve for *Chlorococcum* sp. with audible sound (2500Hz frequency and 60dB loudness for 2 Hrs.) and OD value was taken using 680 nm.

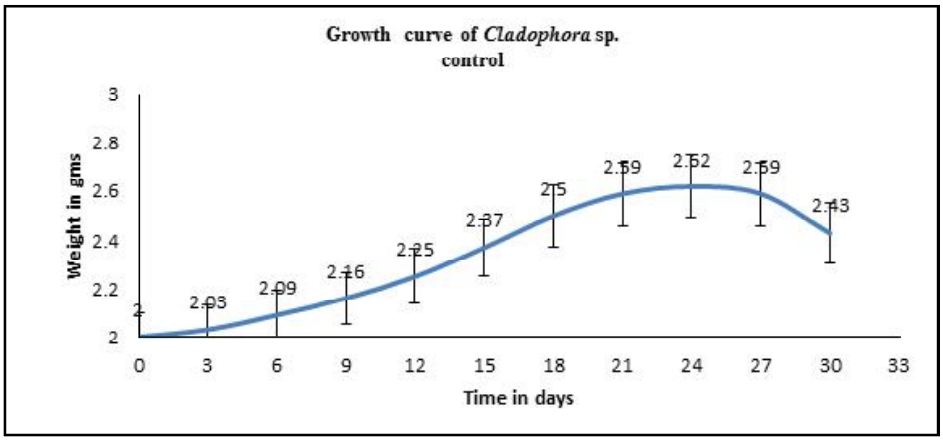

Fig. 3. Growth curve of *Cladophora* sp. control culture.

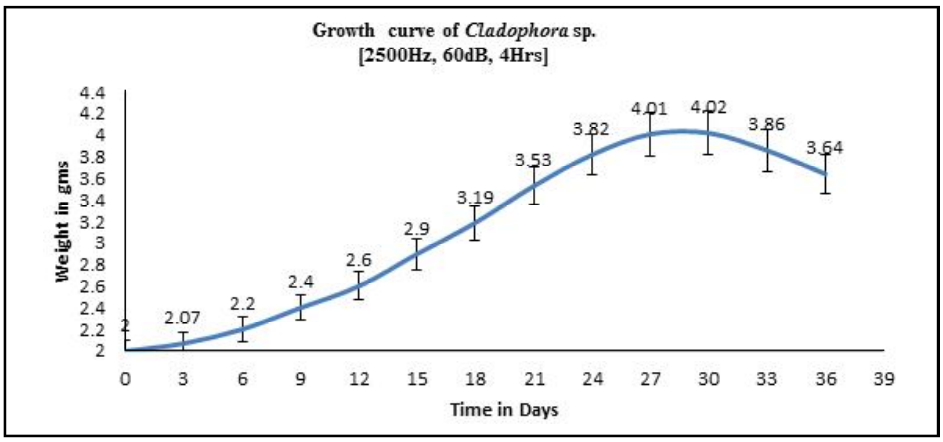

Fig. 4. Growth curve for *Cladophora* sp. with audible sound (2500Hz frequency and 60dB loudness for 4 Hrs.) and OD value was taken using 680 nm.

Both micro and macro algae are highly valuable in ecosystem for their huge impact as primary producer. Unicellular green algae *Chlorococcum* sp. and filamentous green algae *Cladophora* sp. both are well developed as pure culture under laboratory conditions. Audible sound (2500Hz frequency with 60 dB loudness) is applied on both for assessing how much their growth stimulus, is sensed than control conditions and these difference are studied in this paper. For, *Chlorococcum* sp. log phase was seen between days 12 to day 24 and placed for about 12 days under control but using audible sound it showed within day 6 to day 21 and placed for 15 days. In the case of audible sound treatment log phase is increased about 25% than control nature. Both in control and audible sound treatment culture the time span of stationary phase is 3 days but their initial point come forward from day 24 to

day 21 by using audible sound.

For *Cladophora* sp. in control culture log phase displayed within day 3 to day 21 and its period about 18 days but with audible sound treatment its span about 24 days. In the culture with audible sound log phase increased up to 33.33% then control culture. After using audible sound, the stationary phase of this culture became 3 days where as the stationary phase in control culture was 6 days.

In *Chlorococcum* sp. treated with audible sound the highest growth rate found in day 21 in, where as the highest growth rate found in day 24 in control culture. Here cell turbidity increased about 47.45% after using 2500 Hz sound frequency with 60 dB loudness for 2hrs per day when the *Cladophora* sp. treated with audible sound the highest growth rate found in day 30 where the control culture highest growth rate found in day 24. Cell turbidity increased about 53.44% after using 2500 Hz sound frequency with 60dB loudness for 4 hrs per day.

References :

1. Appler, H. N. and K. Jauncey, (1983). *Aquaculture*, *30:* 21-30.
2. Cai, W., S. Zhu, N. Wang, H. He, and B. Ying, (2015). *Int J AgricBiolEng*, *8*(1): 162-169.
3. Christwardana, M. and H. Hadiyanto, (2017). *HAYATI J Biosci*, *24*(3): 149-155.
4. Freeman S. E., L. A. Freeman, G. Giorli, A. F. Haas, and C. A. Radford, (2018). *PLoS ONE*, *13*(10): e0201766.
5. Hassanien, R. H. E., T. Z. HOU, Y. Li, and B. Li, (2014). *J Integrative Agric*, *13*(2): 335-340.
6. Jiang, S., H. Rao, Z. Chen, M. Liang, and L. Li, (2012). *Agric Sci Technol*, *13*(10): 2197-2201.
7. Larsen, P., J. Gilbert and T. Ravasi (2013). *PLoS ONE*, *8*(3): e58119.
8. Messyaz, B., M. Pikosz, G. Schroeder, B. Leska, and J. Fabrowska, (2015a). In: Kim Sk, Chojnacka K (eds), Marine algae extracts: proceses, products, and applications. Wiey-VCH, Weinheim, pp. 15-40.
9. Pikosz, M. and B. Messyasz, (2015). *Oceanol HydroBiol Stud*, *44:* 273-281.
10. Pikosz, M. and B. Messyasz, (2016). *Oceanol Hydrobiol Stud*, *45:* 202-215.
11. Rosen, S. and S. Howell S., (2011). Emerald Group Publishing Limited, 2nd Ed., pp. 33-35.
12. Shiels, K., A. Tsoupras, R. Lordan, C. Nasopoulou, L. Zabetakis, P. Murray, and S. K. Saha, (2021). *Mar Drugs*, *19*(1): 28.