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Full Length Research Paper

Determination of the effect of light and salt concentrations on *Aphanocapsa* algal population

Ifeanyi V. O.[1]*, Anyanwu B. N.[2], Ogbulie J. N.[2], Nwabueze R. N.[2], Ekezie W.[1] and Lawal O. S.[1]

[1]Microbiology Department, Anambra State University, Uli. Anambra State, Nigeria.

[2]Industrial Microbiology Department, Federal University of Technology, Owerri.Imo State, Nigeria.

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The research was on the determination of the effect of light and salt concentrations on *Aphanocapsa* algal population. Microbiological standards were observed in the isolation of *Aphanocapsa* sp from water sample collected from Shell Petroleum flow station. The effect of 5,000, 3500 and 2,000 lux light intensities and 10 g/L through 50 g/L salt concentrations on the growth and proliferation of *Aphanocapsa* sp was determined by a spectrophotometer at 340 nm. At Day 9, the algal species gave the highest optical density of 0.495 nm at 5000 lux. The optimum salinity on the algal growth was 10 g/L and this gave 1.23 nm optical density at Day 9. The control gave 0.45 nm on Day 9. This research monitored the effect various light and salt concentrations had on *Aphanocapsa* sp growth and the optimum light intensity and salt concentration were identified.

Key words: Algae, environmental parameters, light intensity, salt concentration, growth, population.

INTRODUCTION

Algae are free-living photoautotrophic microorganisms that can derive energy from sunlight and carbon from the air. Algae including cyanobacteria are wide spread in many ecosystems including polluted ecosystems (Fogg, 1987; Gibson and Smith, 1982). The growth of algae is greatly affected by the chemical and physical nature of their surroundings. An understanding of the effects of the environmental influences on algal growth would help in the monitoring of an algal population. Some important factors affecting the growth of algae are light, temperature, pH, buoyancy, nutrients and biological factors. Ifeanyi et al. (2010) monitored the effect various pH values had on *Aphanocapsa* sp. and also identified the optimum pH for *Aphanocapsa* algal growth.

Many publications have presented evidence of a natural ability of cyanobacteria and other algae to degrade organic pollutants (Kuritz and Wolk, 1995; Walker et al., 1975; Abed et al., 2002; Lee et al., 1989; Prevot and Soyer-Gobillard, 1987; Ifeanyi, 2007). Bertrand et al. (1983) stated that work is being done to optimize crude oil biodegradation. It should be noted that the majority of studies have been concerned with involvement of bacteria and fungi in biodegradation (Okpokwasili and Amanchukwu, 1988; Chukwura et al., 2005; Adenipekun, 2008). The effects of environmental parameters on the microbial degradation of hydrocarbons have been the areas of interest and the subject of several reviews (Atlas, 1981; Colwell and Walker, 1977). Kuritz and Wolk (1995) noted that cyanobacteria are inexpensive to maintain and they proposed that the use of cyanobacteria be considered for low-cost, low maintenance remediation of pollutants in surface waters against this background, the research aimed at monitoring the effect various light and salt concentrations had on *Aphanocapsa* sp as well as determination of the optimum light intensity and salt concentrations for *Aphanocapsa* sp growth. The knowledge of this will be used to optimize large scale development of the algal species for possible biodegradation and bioremediation.

MATERIALS AND METHODS

Collection of sample

The algal water sample was collected from a river at the Shell Petroleum Development Company (SPDC) drilling site at Mahu

*Corresponding author. E-mail: ifehos@yahoo.com.

Ohaji Egbema, Imo state. Serial dilution of the sample was prepared by adding 1 ml of the sample to 9 ml of factor of 10^{-1} and subsequent dilutions were made up to 10^{-9}

Sterilization of materials and medium

Chu (1942) Soil extract medium also known as E + S medium (with the following composition: water 900 ml, soil extract solution 100 ml, $KN0_3$ 200 mg, $MgS0_4$ $7H_20$ 20 mg, Agar (optional) 10 g, Vitamin B_{12} (Cyanocobalamin) 2 ml, streptomycin 0.1 g and nystatin 0.1 g) was appropriately prepared and aseptically dispensed into pre-sterilized Petri-dishes.

Glasswares and other heat stable materials were sterilized as described by Cheesbrough (2005) and Cruickshank et al. (1980). The enumeration of the alga was carried out by inoculating in duplicates the soil extract medium in Petri dishes using 0.1 ml of 10^{-3} and 10^{-4} dilutions of the water sample, then incubated at 27°C for seven days on a regularly surface sterilized table facing the light source for illumination. Several plating and streaking were carried out before a pure culture was obtained. Identification of the algal species was according to John et al. (2002) guide.

Determination of the effect of light on algal growth

The method of Gupta and Agrawal (2006) was used. The broth of Chu soil extract medium was prepared and 10 ml of it was dispensed into three test tubes and labeled appropriately. Then, 2 ml of *Aphanocapsa* sp was inoculated into each tube and the tubes were positioned at four different distances (on a surface sterilized table) in a dark chamber illuminated with a fluorescence tube placed in that chamber.

The distances were 10, 30, 60, and 90 cm, which with the aid of a pyranometer, gave the light intensities of 7000, 5,000, 3500 and 2,000 lux respectively. A control without illumination was also placed in a chamber. The samples were allowed to grow for two weeks, with constant agitation. Optical density was determined at 340 nm daily.

Determination of the effect of different concentrations of NaCl on *Aphanocapsa* growth

The method of Gupta and Agrawal (2006) was used. The broth of the Chu soil extract medium was prepared and 10 ml of it was dispensed into each of a set of five test tubes and labeled appropriately.

A duplicate set of the tubes was lined up. Into each test tube was inoculated a different quantity of NaCl 10, 20, 30, 40 and 50 g/L respectively. Each tube was labeled appropriately. Then 2 ml of an algal species, *Aphanocapsa* sp was added into the test tubes. A control medium (without addition of NaCl) was kept. Incubation was carried out on a surface sterilized table at room temperature facing a light source.

All these samples were allowed to grow for two weeks, and daily readings of optical densities were taken using a spectrophotometer at 340 nm.

RESULTS

The effect of various light intensities on the growth and proliferation of *Aphanocapsa* sp population was determined and results are as shown in Figure 1. The 7000 lux had a photo inhibition and had no growth. The 5000 lux light intensity had the highest absorbance of 0.495 at 340 nm at day 9th as against 0.360 and 0.275 absorbance recorded at 3500 and 2000 lux respectively. The control had an insignificant growth.

The effect of salt concentrations was determined by measuring turbidity of *Aphanocapsa* sp grown in medium containing different NaCl concentrations. The results are shown in Figure 2. At concentration of 10 g/L, the optical density was 1.200 absorbance and 20 g/L gave 0.620 optical density. Concentrations of 30, 40 and 50 g/L did not have significant growth. The control sample recorded 0.50 optical density. The optimum salt concentration was 10 g/L. The least growth was recorded at concentration of 50 g/L that gave 0.180 absorbance at Day 8.

DISCUSSION

The results of the optimum salt concentration followed by the population in the 20 g/L salt concentration and the control were in line with Kerr and Capone (1988) who observed a better metabolism of hydrocarbon in the moderately saline estuarine sites of Hudson River than the less saline upstream of the same river. The insignificant growth recorded in the samples with higher salt concentrations supports previous studies by Leahy and Colwell (1990) who noted that rates of metabolism decreased with increasing salinity.

The light intensity experiment showed that 5000 lux was adequate for the algal growth. This observation was in line with the report of Lavens and Sorgeloos (1996) who reported that 2500 to 5000 lux and 5000 to 10000 lux light intensity depending on culture depth is optimal for algal growth. The results on light intensity corroborate with Anonymous (1991) who noted that optimal parameters regulating algal growth as well as the tolerated ranges are species specific.

Research on the environmental conditions optimal for algal growth is important because in recent times attention has been drawn to the use of algae for bioremediation. Many researchers had reported on the use of algae in degradation of petroleum oils. These include the studies of Abed et al. (2002), Walker et al. (1975) and Cerniglia et al. (1980a) who observed that nine cyanobacteria, five green algae, one red alga, one brown alga and two diatoms could oxidize naphthalene.

Prevot and Soyer-Gobillard (1987) noted the degradation of parathion in cultures of the marine dinoflagellate-*Porocentrum micans* and Lee et al. (1989) observed the use of microalgae in the biodegradation of Tributyltin in estuarine waters. The effects of environmental parameters on the microbial degradation and optimisation of biodegradation have been areas of interests and reviews (Bertrand et al., 1983; Atlas 1981; Colwell and Walker, 1977).

Similarly, Ifeanyi et al. (2010) reported on the effect of pH on *Aphanocapsa* sp. and they noted that the alga

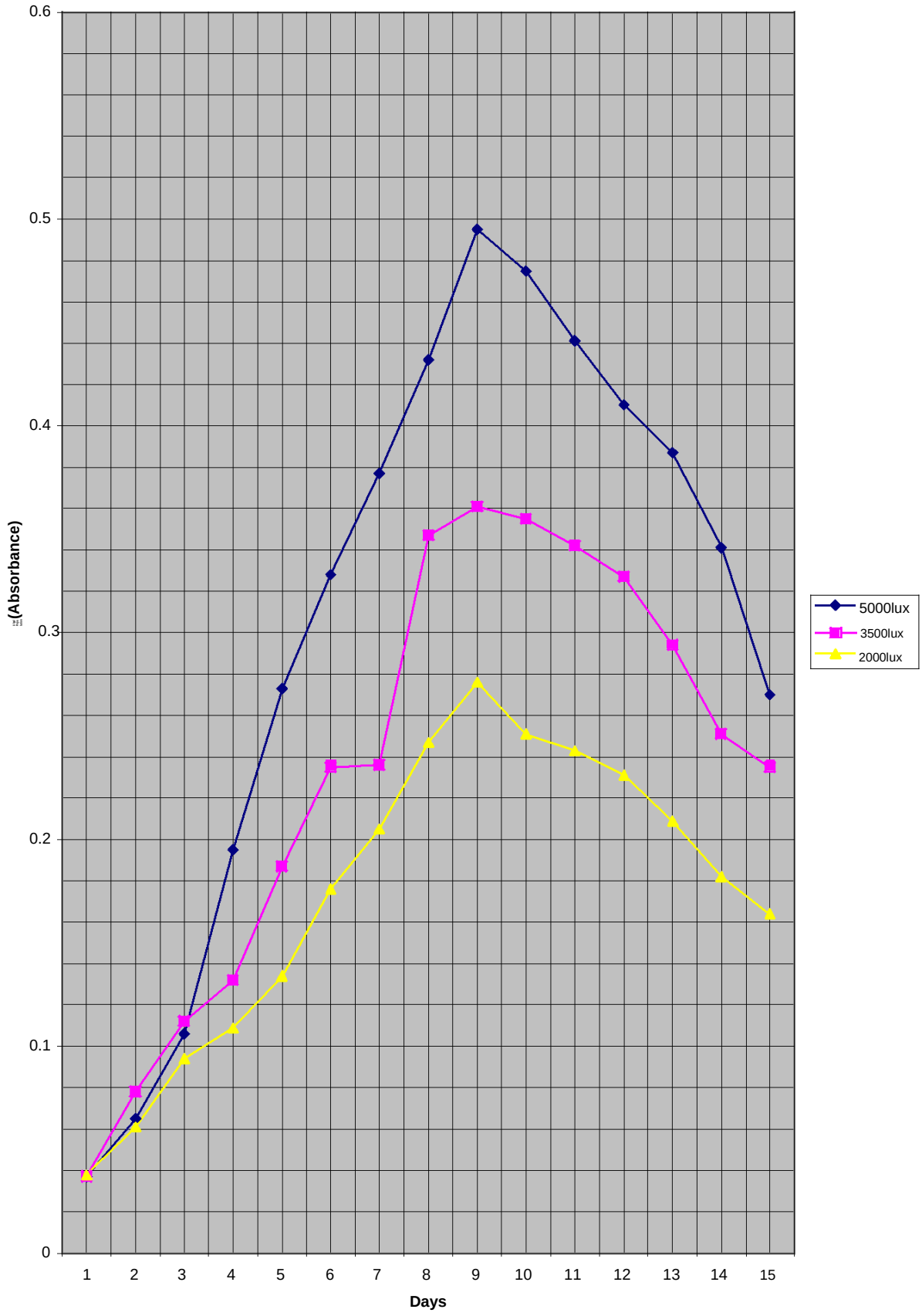

Figure 1. The effect of the light intensities on *Aphanocapsa* population.

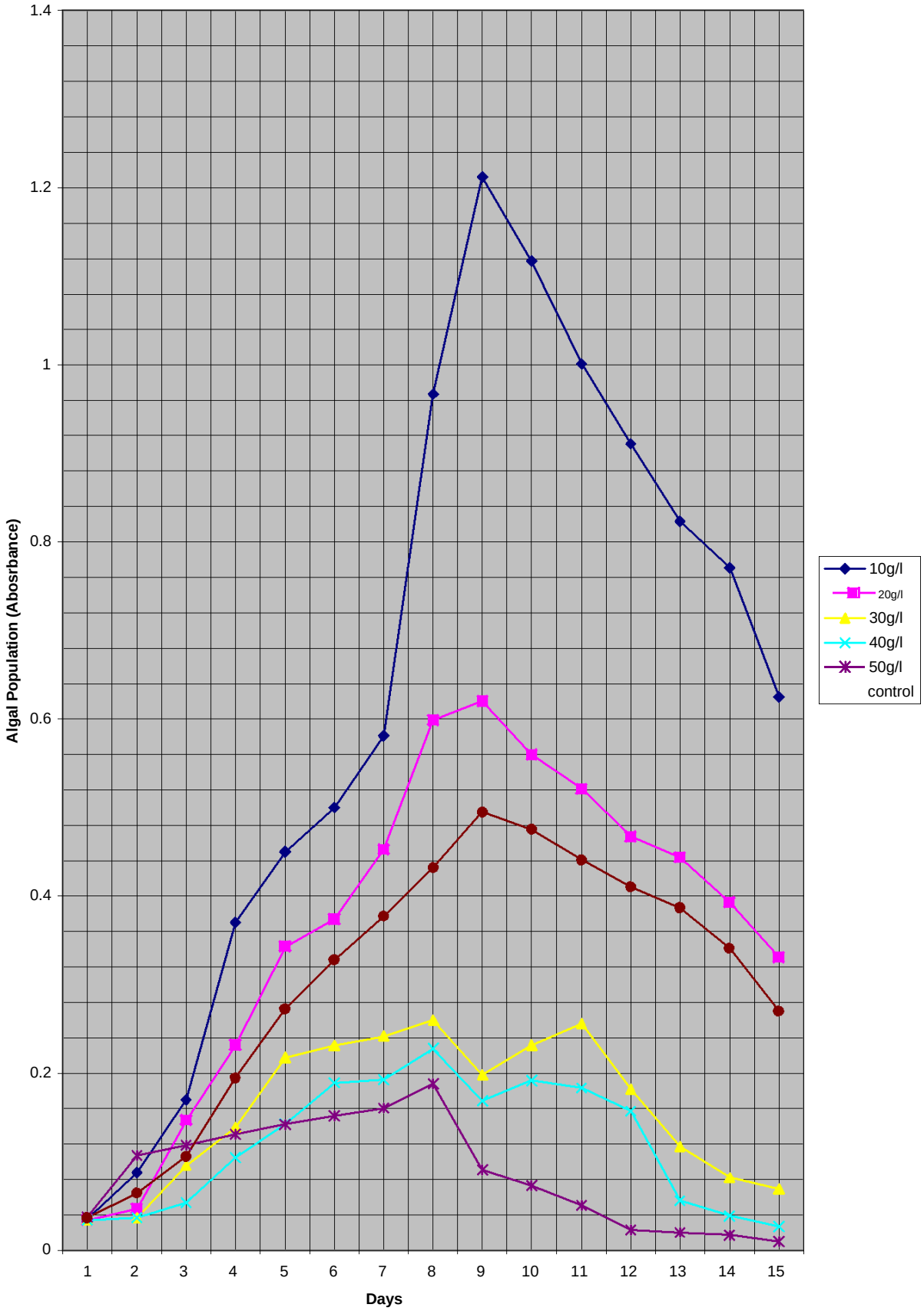

Figure 2. The effect of different salt concentrations on *Aphanocapsa* population.

grew in a unique manner in a range of different pH values. Also, the study of Ifeanyi (2007) on the effects of nitrogen and phosphorus on heavy metals during algal mineralization of crude oil lends more weight to the fact that the effects of environmental parameters on algae are required to meet the challenging demand and review on the use of algae for biodegradation and bioremediation.

Conclusion

This research monitored the effects of light and salt concentrations on *Aphanocapsa* sp growth. The optimum light intensity and salt concentrations on the growth of *Aphanocapsa* sp were studied. From the knowledge obtained, this algal species can be improved for field trials possibly for bioremediation purpose.

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