Presence of Microcystins from Cyanobacteria in Northern California Lakes

Danielle Bisbee[1], Anmol Nagar[1], Dr. Esala Chandrasena[2]
Palo Alto High School[1], California Department of Public Health[2]

INTRODUCTION

Question
What conditions, such as temperature, pH, access to light, and rainfall, are optimal for cyanobacterial growth and microcystin presence?

Hypothesis
After conducting preliminary research, we hypothesize that microcystins are likely to be present in bodies of water that are generally warm and exposed to light. Microcystins break down at pHs that are too acidic or too basic, so a near neutral pH will likely be optimal. Calm weather conditions will likely enhance growth.

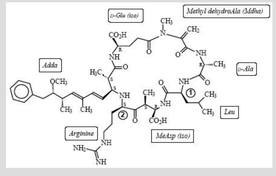
Background
Cyanobacteria is a blue-green algae that produces cyanotoxins, most commonly microcystins. There are at least 80 known types; with microcystin-LR considered to be one of the most toxic. Microcystins are primarily cyclic peptides. When conditions are favorable, cyanobacteria are able to multiply, causing "blooms" that concentrate on the surface. Bloom formation is affected by light intensity and duration, the availability of nutrients (primarily phosphorus), water temperature, pH, precipitation, and water flow. Bloom decay consumes oxygen which creates hypoxic conditions that kill off plants and animals. Some types of cyanobacteria have cavities filled with gas that allow them to float to the wherever there are optimal light and nutrient levels. Under favorable conditions, some species of cyanobacteria will release cyanotoxins, including neurotoxins, hepatotoxins, and dermatoxins. Microcystin primarily affects the liver, causing minor to widespread damage depending on the amount absorbed. These toxins are not deadly to humans in small quantities and the World Health Organization's provisional value for drinking waters is 1.0 µg/L microcystin-LR or less, but they are highly toxic to fish, birds, pets, and livestock.

In California, microcystins have been found in the Salton Sea, the Klamath River and its reservoirs, Lake Mathews, Lake Skinner, Diamond Valley Lake, Lake Perris, and the delta region above San Francisco Bay up into the Sacramento and San Joaquin Rivers.

SIGNIFICANCE, MATERIALS & METHODS

Significance of Topic:
In the fall of 2014, a state of emergency was declared upon the state of Ohio by governor John Kasich after the toxin microcystin was found in local water bodies in the Toledo area, probably because of it's abundance in nearby Lake Erie. The US Environmental protection agency stated that the toxins being released from the microcystins found in Ohio however, could have harmful byproducts especially harmful to the liver if ingested in large amounts. Taking data about what conditions are most favorable to growth of microcystins can help us predict where harmful growth may occur and thus avoid a situation like Toledo, OR by preventing it before it causes harm to humans, or the environment.

Materials:
4.5-10 pH paper
14 mL conicals Thermometer Microcystin test kit



Methodology:
Initially, the plan was to collect samples from various water bodies around the San Francisco Bay area and will be analyzed for pH, temperature and how they affect the growth or presence of microcystins in the local area. Samples will be taken in January and will be analyzed in the Palo Alto High School labs in the following weeks. The materials required will be a pH meter and UV spectrometer. The results will be analyzed around February and March.

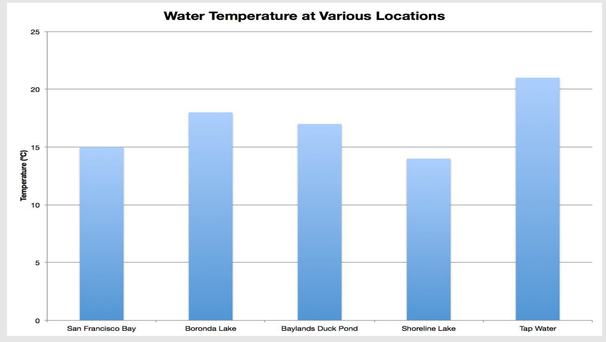
In actuality, the samples were collected in 14 mL conicals from the San Francisco Bay, Boronda Lake at Foothill Park in Palo Alto, the Palo Alto Baylands duck pond, Shoreline Lake, and tap water collected from Palo Alto High School. Temperature was measured on site. pH was measured using 4.5-10 pH paper and a Microcystin test from Abraxis kits was run on the water samples.

RESULTS

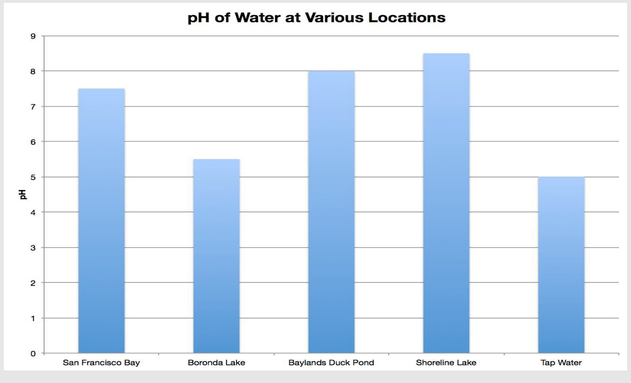
DATA TABLE:

	Water Temperature	pH	Microcystin Test
San Francisco Bay	15ºC	7.5	0-10 ppb
Boronda Lake	18ºC	5.5	0-10 ppb
Baylands Duck Pond	17ºC	8.0	0-10 ppb
Shoreline Lake	14ºC	8.5	0-10 ppb
Tap Water	21ºC	5.0	0-10 ppb

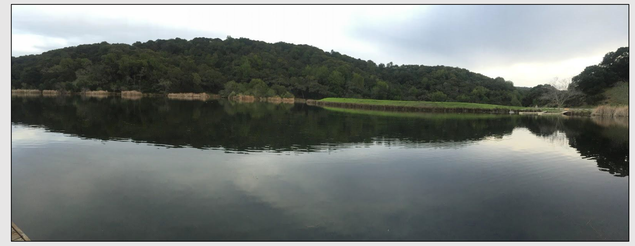
GRAPHICAL REPRESENTATION OF PH

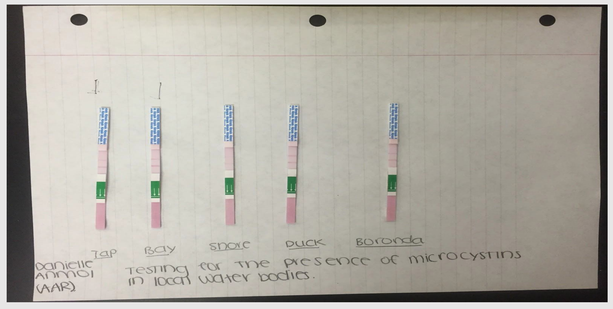


GRAPHICAL REPRESENTATION OF WATER TEMPERATURE



PHOTOS OF SAMPLE SITES:





SUMMARY / CONCLUSIONS

Because all of the lines that appeared were faint, all of the bodies of water all had a concentration of 0-10 ppb. Shoreline Lake had significantly fainter lines than the others, meaning the test was either ineffective or had little to no microcystins. There were no apparent algal blooms in any of the bodies of water. The samples were collected in February, while microcystins are more present in the fall. If they had been collected at another time, the microcystin presence could possibly be higher. There is no apparent correlation between pH, temperature, and microcystins present.

ACKNOWLEDGEMENTS / REFERENCES

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