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Review Ways to Control Harmful Algal Bloom (HAB)

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Abstract: Of the thousands of species of marine algae, a small number are known to produce chemicals that are toxic to other organisms including fish, birds, marine mammals and humans. Bloom algae due to change of water color by pigment is called red tide. Bloom algae that produced toxins are called HABs. Eutrophication, temperature, human activity and etc have been increased bloom algae. Other damages are death of aquatic and losses of economic. mechanical control, chemical control and biological control include (bacterial and virus algicidal and etc) have been used to control algal toxins.. The method used depends on the scale of red tide and the species due to this phenomenon.

Key words: Marine algae · HABs · Biological control · Mechanical control

INTRODUCTION

Harmful algal blooms (HABs) have been increasing in worldwide. Blooms are formed in both marine and freshwaters by a variety of phytoplankton including dinoflagellates, diatoms and cyanobacteria that float to the surface and accumulate, causing water discoloration ranging from reddish to green in color depending on the species [1]

The impacts of these blooms are felt in many ways:

Marine life is exposed to toxins by eating them, breathing them or touching them. The toxins can also pass through cell membranes, including the blood-brain barrier and skin tissue [2, 3]. Different forms of marine life vary in their reaction to the toxins. Fish kills are both an early warning sign for humans and a sad hallmark of red tide blooms. Fish kills of up to 100 tons of fish per day in Florida have been estimated during active red tides. Fish are exposed to toxins by swimming through blooms and ingesting forms of marine life that have become contaminated with toxins. They are thought to be killed through lack of muscle coordination and paralysis, convulsions and respiratory failure [4].

Marine algal toxins are responsible of more than 60000 intoxication/year, with an overall mortality of about 1.5%. Human intoxications are due to consumption of seafood and respiratory exposure to aerosolized toxins [5]. Algal toxins are also responsible for mortality in seabirds, marine mammals and other animals depending on marine food web. Algal blooms occur worldwide naturally in eutrophic waters, generally during warmer temperatures and in areas where there is poor circulation. Recently, factors such as global warming, increased nutrient loading from human activities and transport of algal species via ship ballast waters, have caused an increase in and spread of algal blooms [6, 7]. Methods to control these HABs, to minimize the potential adverse effects on the environment and to mitigate economic loss would be advantageous. Physical, chemical and biological method have been used in freshwater and marine systems for small and large-scale control of HABs due to their significant public health, economic and ecosystem impacts [8].

Biology Control: Biological control methods of algal blooms could include enhancement of existing predators, isolation of novel control species and genetic engineering [6]. Biological control organisms include species that feed, infect, or decompose HAB species. Included among these are copepods and ciliates that graze on algae and dinoflagellates and some viruses, parasites and bacteria that hold promise as control agents because they are abundant in marine systems, sometimes are host-specific and have high reproductive output [9]. For example Diatom is used for control red tide due to *Chattonella* spp. [10]. It is known empirically that *Chattonella* red

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tides occur when diatoms are scarce in surface water Diatoms can dominate over *Chattonella* spp. due to their higher growth rates [11]. Growth of diatoms will exhaust nutrients in the surface layer, which will reduce the growth of *Chattonella*. Another biological method that has been examined for potential ability to mitigate algal blooms is the use of fish. In the past, filter-feeding fish have been examined and found to only filter some large algae [12]. Of the filtered algae, often some are indigestible and can be released back in to the environment to propagate [12]. Other types of fish were then considered in a study conducted by Lu *et al.* that investigates the uses the cichlid *Oreochromis niloticus* (tilapia) against *Microcystis* blooms [12]. Tilapia was found capable of digesting *Microcystis* cells taken from the natural environment [12].

Mechanical Control: Various mechanical bloom control strategies have been identified, but it is not known the extent to which these can be applied to particular HAB species in specific environments or habitats. Physical control involves removing the harmful algal cells via filtration, skimming, ultrasound, electrolysis or similar methods [13]. For various reasons, most techniques tried so far have not proven to be useful for HAB control in actual situations [13]. One promising non-chemical strategy involves the treatment of blooms with flocculant clays which scavenge particles, including algal cells, from seawater and carry them to bottom sediments. Flocculation refers to a process by which a substance is added to a solution to create a "floc" that removes fine particulates by binding with them and causing them to clump together [14]. Clay flocculation can be considered as one of the only HAB control technologies with a partially successful track record in the marine environment [14]. However, environmental consequences of this technique have not been fully evaluated yet [13].

Pumping of surface algal scums from inshore areas has proven be an effective mechanism to temporarily protect recreational users of freshwater lakes from exposure to toxic cyanobacteria and filtration has been used effectively in purification of drinking water supplies [15].

Chemical Control: Chemical control is the use of chemicals to kill or reduce the density of HAB cells. A variety of Chemicals such as copper sulfate, sterol surfactants, sodium hypochlorite, magnesium hydroxide and others have been tried for control of HAB organisms.

In general, most chemicals tried have been too expensive and too non-specific (causing damage to non-target components of the marine ecosystem) for effective use against HABs [13]. Chemicals have been used to treat blooms in drinking water supplies and other enclosed freshwater systems. These include copper compounds, barley straw and chemical oxidants such as chlorine, peroxide, ozone and chloramines [8]. Another interesting approach to bloom control in freshwater lakes and ponds utilizes a blue dye to limit penetration of the wavelengths of light required for photosynthesis and thus the growth of algae [8].

CONCLUSION

Mechanical control, chemical control and biological control include (bacterial and virus algicidal and etc) have been used for control of algae toxins. Mechanical control involves the use of filters, pumps and barriers (e.g., curtains, floating booms) to remove or exclude HAB cells, or other bloom-related materials from impacted waters. Chemical control involves the use of chemical or mineral compounds to kill, inhibit, or remove HAB cells. Biological control involves the use of organisms or pathogens (e.g., viruses, bacteria, parasites, zooplankton and shellfish) that can kill, lysis, or remove HAB cells. The method used depends on the scale of red tide and the species due to this phenomenon.

REFERENCES

1. Sellner, K.G., G.J. Doucette and G.J. Kirkpatrick, 2003. Harmful algal blooms: causes, impacts and detection. J. Ind. Microbiol. Biotechnol., 30: 383-406.
2. Kemppainen, B.W., W.G. Reifenrath, R.G. Stafford and M. Mehta, 1991. Methods for in vitro skin absorption studies of a lipophilic toxin produced by red tide. Toxicon., 66: 1-17.
3. Apland, J.P., M. Adler and R.E. Sheridan, 1993. Brevetoxin depresses synaptic transmission in guinea pig *Hippocampal slices*. Brain Research Bulletin, 31: 201-207.
4. Kirkpatrick, B., L.E. Fleming, D. Squicciarini, L.C. Backer, R. Clark, W. Abraham, J. Benson, Y.S. Cheng, D. Johnson, R. Pierce, J. Zaias, G.D. Bossart and D.G. Baden, 2004. Literature review of Florida red tide: implications for human health effects. Harmful Algae, 3: 99115.

5. Zaccaroni, M., M. Ciuffreda, M. Paganin and L. Beani, 2007. Does an early aversive experience to humans modify antipredator behavior in adult Rock partridges? Ethol. Ecol. Evol., 19: 193-200.
6. Anderson, D.M., 2009. Approaches to monitoring, control and management of harmful algal blooms (HABs). Ocean Coast Manage., 52: 342-347.
7. Davis, T.W., DL. Berry, G.L. Boyer and C.J. Gobler, 2009.The effects of temperature and nutrients on the growth and dynamics of toxic and non-toxic strains of Microcystis during cyanobacteria blooms. Harmful Algae, 8: 715-725.
8. Chorus, I. and J. Bartram (eds.), 1999. Toxic cyanobacteria in water: A guide to their public health consequences, monitoring and management. London: E&FN Spon.
9. Shirota, A., 1989. Red tide problem and countermeasures (2). Int. J. Aquat. Fish. Technol., 1: 195-223.
10. Fukuyo, Y. and F. Taylor, 1989. Morphological Characteristics of Dinoflagellates in Biology, Epidemiology and Management of Pyrodinium Red Tides. Eds. G. Hallegraeff and J. Maclean. Manila, ICLARM.
11. Imai, I.Y., M. Mguchi and M. Watanabe, 1998. Ecophysiology, Life cycle and bloom dynamics of Chattonella in Seto Inland.
12. Lu, K.H., C.H. Jin, S.L. Dong, B.H. Gu and S.H. Bowen, 2006. Feeding and control of blue-green algal blooms by tilapia (*Oreochromis niloticus*). Hydrobiologia, 568: 111-120.
13. Rey, J.R., 2007. Ciguatera. University of Florida, IFAS, EDIS IN742; http://edis.ifas.ufl.edu/IN742.
14. Alcock, F., 2007. An Assessment of Florida red tide: causes, consequences and management strategies. Technical Report, pp: 1190.
15. CENR, 2000. National Assessment of Harmful Algal Blooms in U.S. Waters. National Science and Technology Council Committee on Environment and Natural Resources, Washington, D.C., pp: 38.