Study on the Cause of Cyanobacteria Bloom

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Abstract: The eutrophication of water bodies is becoming more and more serious, and the number of outbreaks of cyanobacterial blooms is increasing. The causes of outbreaks of cyanobacterial blooms should be paid attention to. Based on the analysis of the causes of cyanobacteria, this article clarifies the hazards and controllability of cyanobacteria, comprehensively analyzes the cyanobacterial control measures, examines the advantages and disadvantages of various single treatment methods, and proposes that comprehensive algae removal measures are effective means to crack the cyanobacterial outbreak ; According to the biological characteristics of cyanobacteria, the effective ways and methods of cyanobacteria are revealed.

1. Introduction

With the acceleration of industrialization, the pollution of water bodies is also increasing; at present, eutrophication of water bodies is one of the environmental problems facing China. The most direct manifestation of water eutrophication is the “bloom” outbreak caused by the proliferation of cyanobacteria. Three shallow lakes, Taihu Lake, Chaohu Lake and Dianchi Lake, have experienced cyanobacterial outbreaks every year in recent years. The cyanobacterial outbreaks have also affected people's drinking water problems.

2. Cyanobacteria and Its Hazards

Cyanobacteria are a general term for a class of algae, not a single species; cyanobacteria, also known as cyanobacteria, were traditionally classified as algae and are now classified as bacteria. Cyanobacteria are the most primitive and simple algae with no nucleus. They belong to prokaryotic single-celled organisms. They are the earliest photosynthetic self-produced creatures on the earth. Most of them live in fresh water, a small part in sea water, and they are unrecognizable to the naked eye; However, when cyanobacteria are accumulated in large quantities, the bubble nuclei in the cells can be relied on to float on the water surface, forming a cyanobacterial bloom visible to the naked eye. The blooms in freshwater bodies are mainly Anabaena, Microcystis, Tencelia and so on. Cyanobacteria adopt a “dormant-recovery” breeding strategy. When the temperature in autumn falls, the cyanobacteria begin to enter the dormant period. When the summer temperature rises and the environmental conditions are suitable for growth, the cyanobacteria recover and start activities under the flow of water. It can be well preserved in harsh environments and is difficult to eradicate. Kong Fanxiang [1] and others believed that the outbreak of cyanobacteria was not caused by the explosive propagation of cyanobacteria, but was caused by the “momentary movement” of cyanobacterial groups in the water. Breeding strategies such as cyanobacteria make its life more tenacious, but this habit also indicates a new direction for the treatment of cyanobacteria.

3. The Harm of Cyanobacteria

Harm to water body: The outbreak of cyanobacteria makes the water body turbid, the transparency is reduced and the smell is bad, and the self-purification ability of the photosynthesis and oxygen release of plants in the water is greatly reduced; in addition, the cyanobacterial toxins in the water are not easy to remove. Migration will pollute other water sources; at the same time,

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cyanobacterial blooms increase the chlorophyll content in the water body and turn the water body green, affecting the original ecological landscape of the water body [2].

Harm to animals and plants in water: The proliferation of cyanobacteria will consume a large amount of dissolved oxygen in water, causing fish and other animals to die due to lack of oxygen. The cyanobacteria float on the surface of the water and block the light, which makes the underwater plants slow the rate of photosynthesis due to lack of sunlight, affecting the normal development of plants. The algal toxin secreted by cyanobacteria is mainly MC. A large number of studies have shown that MC can cause lipid peroxidation of cells to cause oxidative damage, and it is hepatophilic to animals; toxicity to animals is more serious in fish and damages its circulation System, digestive system, immune system, etc.

Harm to humans: Algal toxins accumulate in aquatic animals and flow into the human body through the food chain. More studies have shown that cyanotoxins are one of the causes of liver cancer [3]; the acute effect of algal toxins is 100% of pure arsenic Times. Water containing cyanobacterial toxins can cause allergic symptoms when it comes into contact with human skin. People and animals drinking water containing cyanobacterial toxins can cause discomfort.

4. The Cause of Cyanobacteria Outbreak

Researchers have been exploring the causes of cyanobacterial outbreaks. Dokulil and Teubner believe that the advantages of cyanobacteria are caused by a variety of factors, including lake morphology, water temperature, and mixing conditions. Jia Xiaohui et al. summarized the research results of scholars from various countries and pointed out that the outbreak of cyanobacteria is related to internal and external factors. From the perspective of internal factors, cyanobacteria, as the only algae that can use nitrogen in the atmosphere for biological nitrogen fixation, also have a dormant lifestyle. , Can release algae toxins to give itself an advantage in the environment with competitors and predators. These habits make cyanobacteria have a growth advantage over other aquatic organisms and are more likely to cause blooms. Judging from external factors, in recent years, eutrophication of cyanobacterial blooms has occurred in water bodies. The increase of nitrogen and phosphorus in water bodies and the increase of summer water temperature have brought favorable conditions for the growth of cyanobacteria.

With the development of society and economy and the continuous improvement of people's living standards, people's demand for aquatic products is increasing. The development of aquaculture industries such as ponds is of great significance. Pond culture is the main method of aquaculture in China, and it plays an important role in China's fishery production. In 2011, pond aquaculture production accounted for 53% of the country's total aquaculture production, of which freshwater pond production accounted for 70% of freshwater aquaculture production. Statistical results in 20 Qiao years show that the pond culture area in the country accounts for about 35% of the total culture area, and its output accounts for about 65% of the total output. Pond culture is still the main source of aquatic products supply in my country [4].

As a relatively sealed water body, the pond is not smooth during the aquaculture process. At the same time, with the continuous acceleration of industrialization, the environment has deteriorated seriously, and the water body is inevitably subject to great pollution and frequent water quality problems. This has caused many obstacles and challenges for pond aquaculture. Pond blooms are essentially the result of the conversion of material and energy from cyanobacteria. Cyanobacteria are one of the common phytoplankton in pond culture water. With the rapid development of aquaculture, the degree of intensification is gradually increasing, and the investment in water is also gradually increasing. After the decomposition of fish excrement and residual materials in the water a large amount of nitrogenous nutrients are produced. When the load capacity of the water body is exceeded, it will cause cyanobacterial blooms. It is generally believed that the formation of cyanobacterial blooms in aquaculture ponds is caused by the physiological characteristics of cyanobacteria and temperature, light, nutrients, other organisms and other factors. Among them, physical factors such as temperature and light, and chemical factors such as nutrients are external factors. The biological characteristics of cyanobacteria are internal factors. For cyanobacterial

blooms in breeding ponds, biological and physical factors are objective and uncontrollable. The most fundamental reason for the emergence of Hua is that the pollutants discharged into the water body are far greater than the capacity of the water body environment.

There are a variety of biological factors that make cyanobacteria a dominant population in ponds and even outbreaks of blooms. For example, cyanobacteria have pseudo empty cells. The self-buoyancy can be adjusted by means of pseudo air cells, and the buoyancy adjustment of cyanobacteria can stay at any position in the light-transmitting layer of the water body, which makes the cyanobacteria in the natural water body can adjust itself to be conducive to its own growth (obtain suitable light conditions) And nutritional conditions). In order to obtain proper light and radiance, cyanobacteria will also form a surface bloom as part of its ecological strategy to adapt to the environment. Cyanobacteria not only obtain the advantages of competitive light and nutrition through their own physiological and ecological characteristics, but also inhibit the growth of other algae by secreting some biologically active substances including toxins. More and more evidence shows that the biologically active substances secreted by cyanobacteria Accumulation outside the cell can inhibit the growth of other algae, such as art mixture for trace metal elements. Cyanobacteria can secrete neurotoxins such as green algae Ma Jiang, and secreted liver toxins can inhibit the nitrogen fixation of its competitive species. Moreover, some cyanobacteria can also counteract the feeding and digestion of zooplankton and fish by forming a colony of rubber, and gathering cells to form a larger group. These ecophysiological characteristics of cyanobacteria and ecological countermeasures make it possible for cyanobacteria to grow rapidly when the physical and chemical conditions of the pond water are suitable for the growth of cyanobacteria, becoming the dominant species of algae in the pond and likely to further develop to form blooms [5].

Water temperature is an important factor in the formation of cyanobacterial blooms. Generally speaking, as the temperature of the water increases, the monitor algae have become more and more the dominant species of eutrophic algae in breeding ponds. The optimal temperature for most cyanobacteria to form blooms is 20-35°C, while microcystis , Anabaena, Oscillating algae, and Tenebriophyllum such as typical blooms cyanobacteria, the optimal growth water temperature is 25 ° C, when the water temperature is lower than 17 ° C Microcystis aeruginosa growth will be severely inhibited. Tilman et al. proved that the temperature of the water body is the key factor to control the species of planktonic algae through indoor cultivation experiments. In addition, there are related experiments showing that the optimal growth temperature of Microcystis is higher than other algae. Therefore, cyanobacterial blooms in aquaculture ponds generally break out in summer and autumn.

The light conditions in the water also have an important effect on the growth of algae. Most cyanobacteria have strong tolerance to strong light. For example, Microcystis can protect cells from light inhibition by increasing the content of carotenoid in cells. In addition to chlorophyll, cyanobacteria also have phycobiliproteins, so that cyanobacteria can use light (500-600 nm) that cannot be used by other algae, such as green, yellow and color, so it has a wider light absorption band and can more effective use of underwater light for effective photosynthesis for photosynthesis.

In the study of the formation mechanism of blooms, the most studied is the relationship between nutrients and algae growth. With the eutrophication of the water environment, especially the increase of the concentration, it leads to the excessive growth of phytoplankton in the water body, and the composition of the population is also succeeding to the species of cyanobacteria. The environment rich in nutrients such as N and P, high pH, and rich in soluble organic and inorganic substances are all conducive to the formation of cyanobacterial blooms. Only part of the nutrients inputted by aquatic pond farming are ingested by the fish-the remaining part directly enters the water body, and due to the inherent assimilation rate of the nutrients for the fish, a considerable part of the nutrient intake enters the water body in the form of excreta: many ponds Close to farmland, non-point source pollution such as excessive application of nitrogen fertilizer and large amount of direct loss of livestock and poultry manure and urine will also pollute the pond, resulting in serious eutrophication of the pond water body, not only rich in N and P, but also rich in various Soluble organic matter and inorganic matter; the water body of the breeding pond is generally high in pH

(weakly alkaline). These factors make the pond water of summer and autumn seasons extremely prone to excessive growth of phytoplankton and outbreak of cyanobacterial blooms.

5. Control of Cyanobacteria

The outbreak of cyanobacteria is not caused by the rapid growth of cyanobacteria in a short time, but caused by the “momentary movement” of cyanobacteria due to various environmental factors such as the flow of water. It can be combined with its growth characteristics to take measures to effectively prevent.

The outbreak of cyanobacteria is caused by the eutrophication of the water body, and the discharge of some nitrogen and phosphorus-containing nutrients into the water body should be reduced; in production and life, people should pay attention to the use of pesticides, direct discharge of domestic sewage and factory sewage.

According to the living habits of cyanobacteria sinking to the bottom for dormancy, you can use the dredging method. This method is to dig away the mud from the bottom of the cyanobacterium before the outbreak, but this method has little effect and cannot guarantee that all the cyanobacteria will be removed. And the project is vast and not ideal from an economic perspective.

In addition, it can also strengthen the dissolved oxygen capacity by increasing the disturbance of the water body, and it also has a certain effect on the control and control of the exposure of cyanobacteria. The removal of cyanobacteria “bacteria” in the early stages of cyanobacteria recovery in summer and the dormancy period of autumn cyanobacteria can also effectively control the amount of cyanobacteria and prevent the outbreak of cyanobacteria. Comprehensive removal of cyanobacteria is still an area that needs to be explored. From the perspective of environmental protection, some plants with their own adsorption effect can be used to adsorb cyanobacteria, such as waste corn stalks, fallen leaves of trees, etc. These biomass materials have low cost and wide sources, and don’t worry about recycling.

6. Conclusion

Today and in the future with the rapid development of industrialization, the eutrophication of lakes is becoming more and more serious, the probability of cyanobacterial outbreaks is increasing year by year, and the prevention and treatment of cyanobacteria cannot be delayed. Combining with the causes of cyanobacterial outbreaks, prevention and control at the source is the key. It is necessary to cut off the nutrient source of cyanobacterial growth in a timely manner; comprehensive treatment is an effective means of cyanobacterial treatment. It turns waste into treasure.

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