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Review Article

Human Intoxication of Microcystins

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Abstract: Microcystins are one kind of hepatotoxins produced by freshwater cyanobacterial species, primarily *Microcystis aeruginosa*. Microcystins are chemically stable, but suffer biodegradation in reservoir waters. The most common member of the family, microcystin-LR. Human illness is due to microcystins include gastroenteritis and allergic/irritation reactions, the primary target of the toxin is the liver, where disruption of the cytoskeleton, causes massive hepatic haemorrhage. To remove these from water helps to prevent these diseases. The present paper provides the information on cyanotoxins, their impacts and remedial methods.

Keywords: Cyanobacteria, Microtoxins, Pollution, Water treatment, Antimicrobial agents

INTRODUCTION

Cyanobacteria are oxygenic photosynthetic gram negative bacteria formerly known as Blue Green Algae. The production of oxygen by Cyanobacterial photosynthesis contributes to keeping the balance of the atmosphere. These are often referred as “Architects of earth’s atmosphere”. Cyanobacteria form in shallow, warm slow moving o still water. They are made up of cells with toxins called cyanobacterial toxins. A mass of cyanobacteria in a body of water is called blooms. When this mass rises to the surface of the water is called surface scum or a surface water blooms.

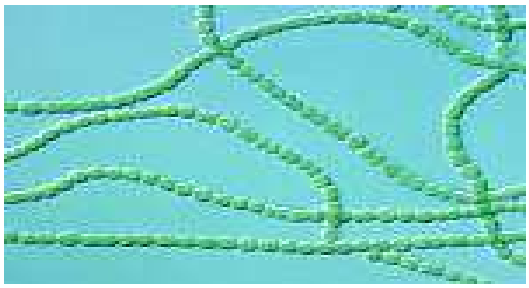

Fig. 1& 2: Cyanobacteria

Cyanobacterial toxins such as Anatoxins-a, Cylindrospermopsin, Nodularin, and Saxitoxins Anatoxin-a (S) are the naturally produced poisons stored in the cells of certain species of cyanobacteria. These toxins fall into different categories. Some attacks the liver (hepatotoxins) or the nervous system (neurotoxins); others simply irritate the skin[1]. These toxins are usually released into water when the cells rupture or die. One group of toxins produced and released by cyanobacteria are called *microcystins* because they were isolated from a cyanobacterium called *Microcystis aeruginosa*. Microcystins are the most common of the cyanobacterial toxins found in water, as well as being the ones most often responsible for poisoning animals and humans who come into contact with toxic blooms[2]. Microcystins are extremely stable in water because of their chemical structure, which means they can survive in both warm and cold water and can tolerate radical changes in water chemistry, including pH.

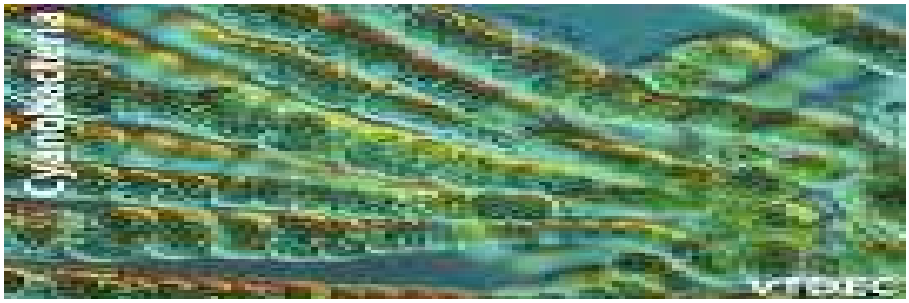

Fig. 3: Cyanobacterial toxins - Microcystins

One of them, microcystin-LR, appears to be one of the microcystins most commonly found in water supplies around the world 30 and 50 per cent of cyanobacterial blooms are harmless because they contain only non-toxic species of freshwater cyanobacteria. Blooms containing even one species of toxic cyanobacteria will be poisonous and potentially dangerous[3].The depth at which cyanobacterial blooms float depends on a number of parameters. The most important factors in these are light, phosphorus and nitrogen

Although many people have become ill from exposure to freshwater cyanobacterial toxins, death from algal-contaminated drinking water is unlikely to occur given that water resources are usually effectively managed to control taste, odour and other algae-related problems. It's possible that extended exposure to low levels of cyanobacterial hepatotoxins could have long-term or chronic effects in humans[4].

By ingesting water, fish or blue-green algal products containing elevated levels of toxins, causes headaches, fever, diarrhoea, abdominal pain, nausea and vomiting. When a person swims in contaminated water, he may get itchy and irritated eyes and skin, as well as other hay fever-like allergic reactions[5]. If anyone contact with cyanobacterial toxins and are experiencing any of these symptoms, Children are at greater risk than adults of developing serious liver damage should they ingest high levels of microcystins, because of their comparatively lower body weight.

There have been many widespread incidents of poisoning, affecting a variety of both wild and domestic animals[6]. Animals are not more sensitive than people to the effects of the toxins; they are simply not as concerned with the way water looks or smells before they drink it. Death is usually caused by damage to the liver or to the nervous system, depending on which toxins were predominant in the water.

Once cyanobacteria are detected in the water supply, treatment plants can remove these toxins in a number of ways. Conventional water treatment facilities can remove the cells by adding chemicals that bind them together. As the cells clump together, they become heavier and fall to the bottom of the reservoir or tank, where they can be easily filtered out.

While this method will remove cells, it will not remove potentially harmful cyanobacterial toxins[7]. These can be removed using certain oxidation procedures or activated charcoal. Generally speaking, chemicals (such as copper sulphate) or any other treatment method that causes the cells to break down and release their toxins should not be used.

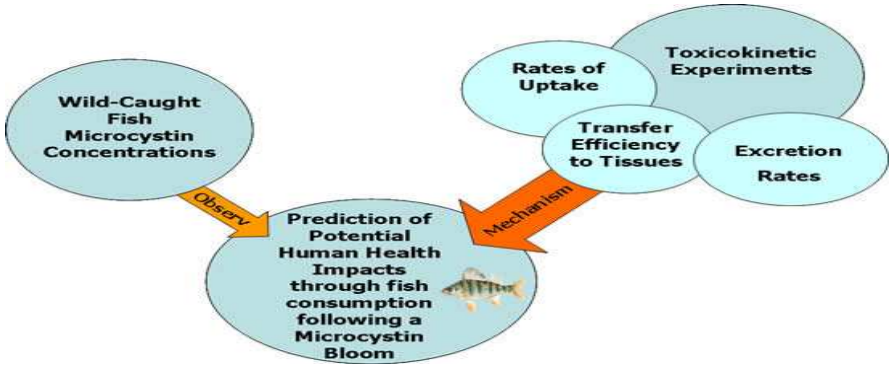

Fig. 4: Microcystins and impact on human health

The best way to avoid the problems associated with cyanobacterial blooms is to prevent blooms from forming[8]. This can be done by reducing the input of nutrients, such as phosphates, into the water source or by mixing the water in a reservoir.

While the proposed level of microcystins allowed for drinking purposes will not adversely affect the health of most people, patients undergoing renal dialysis treatment may be more susceptible to the associated health risks[9]. Because dialysis patients receive dialysis two or three times per week (exposure to more than 300L of water per week), there is potential for dialysis patients to be exposed to elevated levels of these toxins.

Conventional surface water treatment processes are usually effective in removing the algal cells, but are not very effective at removing or destroying dissolved toxins, particularly from supplies that contain high levels of organic material. Specialized surface water treatment processes can reduce the toxin levels to below the drinking water guideline, but these levels (0.1-0.5 µg/L) are still of concern for dialysis patients.

These treatments can range from granular activated carbon filtration followed by reverse osmosis to much more complex membrane filtration systems (e.g., ultra filtration). The extent of additional treatment will depend entirely on the quality of the municipal water supply.

Blooms in recreational bodies of water are usually associated with unpleasant odour and offensive appearance on shorelines as the scum accumulates and decays[10]. Although cyanobacterial toxins are probably not absorbed through the skin, they can cause skin irritation. The toxins, if present, can be absorbed from the water via ingestion or can become airborne and be absorbed via inhalation. Individuals should avoid swimming and other water-related activities in areas with dense blooms.

Because all cyanobacterial blooms are potentially toxic, it's always best to stay away from contaminated water until it has been tested and declared safe. Microcystins can accumulate in the tissues of fish, particularly in the viscera (liver, kidney, etc.), and in shellfish. Levels in the tissues depend upon the severity of the bloom in the area where the fish or shellfish are caught or collected[11]. In general, caution should be taken when considering the consumption of fish caught in areas of a water body where major blue-green algal blooms occur; in particular, the viscera of the fish should not be eaten.

Blue-green algal products are sold in some pharmacies and health food stores as food supplements, often in tablet or caplet form. In particular, adult consumers who choose to use products containing non-*Spirulina* blue-green algae should do so for short periods of time only. However, consumers can safely use products made only from *Spirulina* blue-green algae as these were found to be free of microcystins.

CONCLUSION

Cyanobacteria are photosynthetic prokaryotes have been recognized as excellent source of chemicals, renewable fuels and bioactive compounds. These are also having properties such as antimicrobial and antifungal activities. But at the same time they contain toxins. By removing these toxins by water treatment, the products without these toxins are highly helpful to human and animal health care.

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