Toxic Algae and Effects of Algal Poisoning in Animals and Human Beings

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ABSTRACT

Algae include primitive thalloid plants having enormous uses. Despite of many beneficial activities, some algae cause sickness or death to the living organisms, called ‘toxic algae’. Not only fresh water algae are toxic but marine algae are also toxic. A species may have different strains, some of which may be toxic and other non-toxic. Toxic algae affect different body parts of an organism. Algal blooms which generally appear in green, blue or brownish colour in warm seasons for longer duration, can look like foam, scum, or mats or like paint floating on the surface of water, contain a large numbers of pigmented cells and hence composed of bio-toxins. These toxins are secondary metabolites which are produced by a variety of algal species and harmful to organisms. The present paper describes the toxic algae belonging to Cyanophyceae, Dinophyceae, and Chlorophyceae groups; toxins produced by algae, and the effects of algal poisoning on animals and human beings.

Keywords: Algae, Toxins, Poisoning, Cyanophyceae, Dinophyceae, Chlorophyceae

INTRODUCTION

Freshwater algae being a natural part of the aquatic ecosystem, when growing out of control under suitable environmental conditions like stagnant, warm water and in nutrient-rich level, may be due to the addition of fertilizers and its runoff in to the water bodies, if not managed effectively; sometimes produces toxic or harmful effects in the life of other organisms like fish, marine mammals, birds, and even human beings (Amasha & Aly, 2019; Alshehri, 2020). Harmful algal blooms promoted by human activities as well as climate change (Sinha et al., 2017; Gobler, 2020; Trainer et al., 2020; Burford et al., 2020). Mostly toxic algae belonging to Cyanophyta and dinoflagellates have been reported. The toxicity depends on the ecological and developmental conditions of the algae. Environmental conditions influence the biosynthesis of toxin production in algae (Boopathi & Ki, 2014). Secondary metabolites play role in the colonization and bloom formation (Kurmay et al., 2016).

Algal poisoning has been reported from Argentina, Australia, Bermuda, Brazil, Britain, Canada, Central America, Finland, Israel, Morocco, New Zealand, North America, Russia, South Africa, and U.S.A. (Kamat, 1982). It may be noted that Microcystis aeruginosa is a common alga throughout India. In temple ponds, it is probably the most common alga, but no toxic effects are recorded. Anabaena flos-aquae is also not rare in India. It is customary and religious also for the devotees to wash their feet and hands and even gargle with water from the temple ponds. This is a sort of ritual and it is certainly unhygienic when the water contains bloom (Kamat, 1982).

RESULTS AND DISCUSSION

Examples of Toxic Algae

Cyanophyceae

Dinophyceae
Gymnodioum brevis, G. flavum, G. mikimotoi, G. veneficum, Chlorella and Scenedesmus

Chlorophyceae
Chlorella

Toxins Produced by Algae

Toxins may be produced according to the strains of the different species. According to Gorham et al. (1964) toxin of Anabaena flos-aquae, A. lemmermannii, is a polypeptide. The toxin of Microcystis is a non-volatile, acidic component with great absorption qualities and is a neurotoxin. It is a cyclic peptide composed of about 10 amino acids; some of them are D-serine, L-ornithine, aspartic acid, and glutamic acid. Gorham et al. (1964) isolated 28 strains of Microcystis aeruginosaout of which less than 1/3 rd produce FDF. He also found that...
Different strains of this alga are genetically heterogeneous for toxin production. The toxin of Prymnesium pervum is nondialyzable, thermolabile, and Acldlabile. The endotoxin of Gonyaulax is lethal. It is a toxin with a chemical formula C_{16}H_{31}NO_5. It can be stored for many months without losing its strength. The toxin is thought to be ten times more potent than strychnine and its effects are more like those of Botulinum poisoning. One milligram of the toxin injected is sufficient to kill a mouse.

The toxin of Gymnodinium veneficum is water-soluble, ether soluble, acid labile, of high molecular weight, and acts on the nervous system.

**Effects of algal poisoning**

Algal toxins have been found poisonous to fishes, shell fishes, mussels, live stocks, cattle, horses, swines, water fowls, ducks, chickens, birds, etc, and even human beings. Symptoms and survival time vary from case to case. Cases of the death of a full grown cow and other cattle in ½ an hour or less are known (Kamat, 1982).

Besides death, the harmful effects of algae (e.g. Microcystistoxica) include loss of weight, weakness, liver pathology, abortion, etc. Some pigments like phycocyanin are sensitive to light and when they are in blood capillaries, cause internal burning and peeling of the skin.

The toxic extract from Microcystis when given to animals shows an enlargement of the liver tissue, a failure of blood to clot, and congestion within the spleen (Kamat, 1982).

The toxin produced by Gymnodinium affects both nerves and muscles and inhibit the response of skeletal muscles to acetylcholine by depolarizing membranes over which nerve impulse pass.

Symptoms produced by toxins of Gonyaulax are dizziness, nervous disorders, and death within 30 minutes and 24 hours respectively.

**Algal poisoning in Animals**

Dogs and livestock account for majority of cyanotoxin poisoning in animals (Wood, 2016). An overview of cyanobacterial poisoning in livestock, wild mammals and birds has been studied by Stewart et al. in 2008. Poisoning of fish and other animals have been reported by a large number of workers as under:

Gymnodinium veneficum, a dinoflagellate is known to be toxic to mussels along the coasts of California and Washington.

The toxic of Gymnodinium enough to kill whole schools of fish within many square miles particularly in the gulf of Mexico, and the New Jersey coast where the alga forms the Red tide (Kamat, 1982).

Kamat (1982) has also reported the following examples:

1. Perch and crappies were killed in an aquarium containing Aphanizomenonflos-aquae, even though oxygen was maintained at 8 ppm.
2. Laboratory animals, when given extracts from Microcystis, Anabaena, and

Algae grow abundantly in water reservoirs where an excess of nutrients are available to them. This algal growth floats on the water surface and looks like foam or soap/other. In warmer season these blooms progress and persist for longer duration (Moore et al., 2015; Griffith's et al., 2019). It is called water bloom. The harmful algal blooms responds to climate change.
It can be concluded from the present study that algal members mostly belonging to cyanophyceae are more toxic followed by dinophyceae and Chlorophyceae. Environmental factors like light intensity and temperature leading to more accumulation of algal biomass and hence algal toxin production which ultimately have harmful effects in aquatic life as well as in the animals and human beings on land directly or indirectly.

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REFERENCES


