Cyanobacteria and human health

Cyanobacteria (blue-green algae) are true bacteria of the class Photobacteria. They are amongst the oldest forms of life known and are widespread in aquatic environments, most notably in freshwater lakes and reservoirs. Those cyanobacteria that have most relevance for man are the planktonic forms that float free in the water, particularly when they float to the surface to form a scum or “bloom”.

It has been known for many years that cyanobacteria can cause disease in animals or man. However, two incidents during the summer of 1989 stimulated renewed interest in their public health significance. One incident caused the death of dogs and sheep on Rutland Water, and the other caused a respiratory illness in army cadets after canoeing on Rutyard Lake. This interest led, in part, to a report of the National Rivers Authority.

Cyanobacteria produce various toxins, which are amongst the most lethal substances known; e.g., the LD50 of the peptide toxin, microcystin-LR, for man is 50 μg/kg, compared to an LD50 of 10000 μg/kg for sodium cyanide. Such peptide toxins are the major cause of poisoning of animals and, probably, man. In animals, they cause weakness, diarrhoea and vomiting, cold extremities, pilo-erection, and death within 2–24 h. Major effects are seen in the liver, and pulmonary vein thrombosis has been reported. Recently, it has been shown that microcystin-LR is a highly potent and specific inhibitor of protein phosphatases 1 and 2A. Some cyanobacteria produce potent neurotoxins. Anabaena flos-aquae produces anatoxin-a, which is an alkaloid cocaine analogue, and causes death in experimental animals within 5–30 min from respiratory paralysis. Anabaenopsis flos-aquae produces neosaxitoxin, which causes paralysis by reversibly blocking sodium conductance in neurones. In addition, lipopolysaccharide endotoxins have been demonstrated in some blooms. Some algal toxins are also potent tumour promoters in animal models.

Human disease can be acquired by contact with water containing cyanobacteria, by consumption of fish from waters containing cyanobacteria, or by drinking mains water taken from reservoirs that have been contaminated with cyanobacterial toxins. The range of human illness associated with cyanobacteria has been reviewed recently. Human illnesses following direct contact with algal blooms include symptoms of allergic rhinitis, conjunctivitis or dermatitis. In one report, a physician developed painful diarrhoea following accidental immersion in a lake and, subsequently, began passing slimy green faeces containing Microcystis and Anabaena spp. In the UK, two army recruits were admitted to hospital recently suffering from fever, basal pneumonia, vomiting, sore throat and blistering around the mouth after canoeing exercises on a reservoir with a Microcystis bloom.

There have been several outbreaks of gastroenteritis associated with algal blooms on reservoirs supplying potable water. In Australia, an outbreak of severe illness occurred in an aboriginal area and was linked to cyanobacterial contamination of the water supply. The illness began as an acute hepatitis with malaise, anorexia, vomiting and tender hepatomegaly. Acidosis, hypokalaemia and other serum electrolyte abnormalities occurred in 82% of cases and 39% developed diarrhoea, frequently associated with frank blood. All affected individuals survived, recovery taking 4–26 days. Another Australian study suggested that Microcystis blooms in a water supply reservoir could cause subclinical hepatitis; γ-glutamyl-transferase levels were higher in the population receiving drinking water from a reservoir with a bloom than in a neighbouring population. In contrast, before and after the bloom, liver enzyme levels were similar in the two populations. A 4-week outbreak of pyogenic reactions in an American dialysis unit was linked to high levels of endotoxin in the mains water supply. The epidemic corresponded with a period of high cyanobacterial counts and a bloom in the water supply reservoir. When the algal counts declined the outbreak stopped.

More recently there have been reports of diarrhoea associated with the presence of a cyanobacterium-like body (CLB) in the stool. Long et al. described eight patients with explosive watery diarrhoea and CLBs in their stool. Seven of these patients had travelled recently to tropical countries and four had acquired immunodeficiency syndrome (AIDS). In a subsequent article, three further outbreaks of diarrhoea associated with CLBs affecting over 100 patients in South East Asia and the USA were reported. The outbreaks were all characterised by intermittent diarrhoea, extreme lassitude, abdominal pain, anorexia, fever, myalgia and weight loss.

It is clear that cyanobacteria are a potential hazard to human health. However, the degree of risk is not clear. Good quality epidemiological studies, complemented by careful microbiological and biological assessment of exposed individuals and environmental sites, will be required before the risk can be quantified.

P. R. HUNTER

Public Health Laboratory, Hoole Lane, Chester CH2 3EG.
References