Monitoring of Algae & Cyanobacteria in freshwater

Australian Water Quality Centre

Sampling Requirements:

- Clean plastic bottles of 250mL to 1 litre
- Air gap essential
- Should be received within 24 hours of collection in an unpreserved state
- Preferable if preserved in Lugol's Iodine Solution soon after collection.

Microscopic identification & enumeration of algae and cyanobacteria and quantification of their biomass.

Why do we monitor Algae and Cyanobacteria?

Planktonic algae and cyanobacteria are microscopic photosynthetic organisms which are a natural and essential component of all surface water environments. As autotrophic organisms, they form the basis of the food chain in aquatic ecosystems and rely on a combination of sunlight, a source of nutrients and other physico-chemical conditions for their growth. The composition and abundance of phytoplankton may be used as an indicator of trophic status of a water body.

Under favourable environmental conditions, some planktonic species can grow rapidly to form large accumulations called 'blooms', which may adversely affect the water quality of sources that are used for drinking, agriculture and recreation. Even at moderately low numbers, certain types can impart tastes and odours and interfere with a range of water treatment processes such as coagulation and filtration. Cyanobacteria (also known as 'blue-green algae') are of most concern in freshwater lakes, reservoirs and rivers, because certain species can produce toxins which are a serious hazard to human and animal health.

Periphyton is a collective term that refers to algae and cyanobacteria that grows attached to a benthic substrate, such as submerged rocks, sediment or aquatic plants. Benthic mats that dislodge from sub-surface substrates may contribute to the impairment of water quality in public water supplies through the production of odorous metabolites and toxins. Periphyton can also be used as a biomonitoring tool to assess ecosystem health of riverine environments and monitoring programs that target substrates such as rock biofilms can be designed to compare the diversity and abundance of the algal assemblage in pristine and impacted sites.

Monitoring Cyanobacteria for compliance against Water Quality Guidelines

Monitoring programs tailored to the management of water quality in public water supplies are generally focussed on the determination of trends in population growth of nuisance or noxious organisms, more so than their detection at very low levels. An evaluation of the risk presented by these organisms can then be determined, based on their growth rate and abundance relative to water quality guidelines and compliance levels established for a particular water use.

NH&MRC Guidelines are in place for the monitoring of potentially toxic species of cyanobacteria and their toxins in Australian drinking waters and recreational waters. These guidelines are couched in terms of an Alert Level Framework and in the absence of adequate toxicity data, the cell number and/or biovolume is used as a surrogate to trigger the appropriate management response to a water quality incident. The key toxic species of interest in Australian freshwaters are *Microcystis aeruginosa, Anabaena circinalis, Cylindrospermopsis raciborskii and Aphanizomenon ovalisporum.*

Microscopic Identification and Enumeration: Algae and cyanobacteria are identified by traditional microscopic methods, based upon the key morphological features that are used to classify the various groups, including green algae, diatoms, phytoflagellates and blue-green algae (or cyanobacteria), down to the appropriate taxonomic level. For most purposes, reporting to genus level will suffice, but potentially toxic cyanobacteria should be identified to species level. Estimates of abundance for unicellular, filamentous and colonial forms are determined by the enumeration of individual cells in calibrated counting chambers with or without a pre-concentration step.

Estimates of Algal Biomass: Algal Biovolume provides a measure of cell biomass and is calculated by multiplying the approximate cell volume by the cell count for each species of interest. It is determined from the application of appropriate geometric formulae to estimate species specific cell volumes and accounts for the significant differences in cell size between genera and species. It is most often applied to the monitoring of total or potentially toxic cyanobacteria, where Alert Levels are generally expressed in terms of both cell number and biovolume compliance levels.

Algal biomass can also be estimated by the measurement of chlorophyll a, the major pigment in all photosynthetic plants. Chlorophyll is a non specific measure of biomass that is determined at AWQC by spectrophotometric methods. Phaeophytin is a degradation product of chlorophyll and is often reported simultaneously to provide an indication of the physiological status of an algal population.

Algal Analytical Services Provided by AWQC (* denotes NATA accreditation)

Test	Method	Units	Limit of Reporting	Types of Samples & Common Monitoring Objectives
Algal Scan*	Microscopic identification to species level for noxious cyanobacteria; otherwise to genus level	Relative abundance estimates only	N/A	Semi-quantitative appraisal of phytoplankton or periphyton composition.
Full Enumeration*	Microscopic ID and enumeration of all (> 80%) algae & cyanobacteria	Cells/mL	1 cell, colony or filament/mL	Ecological investigations of phytoplankton or periphyton community structure.
Partial Enumeration*	Microscopic ID and enumeration of the dominant and noxious species	Cells/mL	1 cell, colony or filament/mL	Phytoplankton in all surface waters for water quality assessment.
Total Cyanobacteria Enumeration*	Microscopic ID and enumeration of all cyanobacteria	Cells/mL	1 cell, colony or filament/mL	Cyanobacteria in drinking water supplies and recreational waters for water quality assessment.
Cyanobacteria Biovolume*	Microscopic estimation of cell volume for specified or all cyanobacteria	mm^3/L	0.001 mm^3/L	As above
Algal Cell Viability	Fluorescence Microscopy	N/A	N/A	Investigations of physiological status of algae & cyanobacteria for water supply operations.
Chlorophyll *a* & *b**	Spectrophotometry	µg/L	0.2 µg/L	Long term assessment of trophic status and environmental impacts on aquatic ecosystems.
Chlorophyll *a* & Phaeophytin	Spectrophotometry	µg/L	0.2 µg/L	As above. Assessment of physiological status of algal populations.
Hot & Cold Odours	Olfactory determination	Descriptor and intensity rating	N/A	Assessment of biological and non-biological sources of odour in drinking water supplies.

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