Toxic cyanobacteria blooms in Portuguese freshwaters – a summarized overview

Lisbon, Portugal
6 to 8 November 2008

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INTRODUCTION

Toxic cyanobacteria are common in Portuguese freshwaters and are a cause of concern, given that exposure to subacute levels of cyanobacterial toxins through drinking and recreational water might have deleterious effects on human health. Since 1996 several laboratories have been involved in the screening of cyanotoxins in different freshwater bodies, some on regularly basis and others more sporadically. Here we summarized the main data obtained by our laboratory during the last years, in order to give a simplified overview of the quality and diversity of our freshwater resources in terms of cyanobacteria occurrence.

MATERIALS & METHODS

Water bodies screened in our laboratory are geographically spread through the Tagus basin and southern Portugal (Fig. 1).

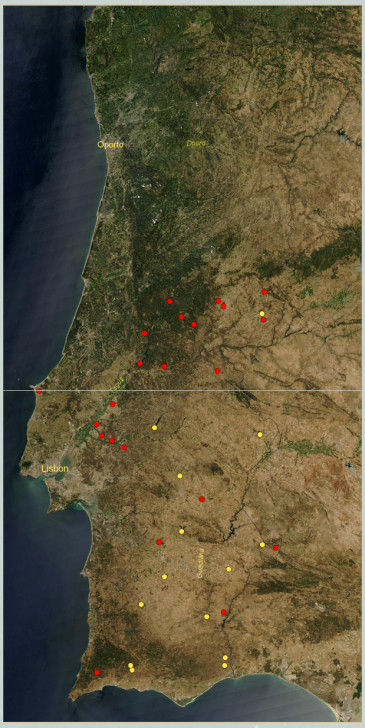
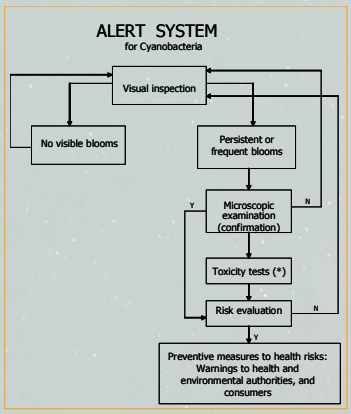


Fig. 1 – Geographical distribution of water bodies screened in our laboratory.
- regular sampling sites;
- sporadical sampling sites.

Surveillance strategy for preventing health risks from cyanobacteria and cyanotoxins in freshwater is based on the alert scheme shown bellow.



Key steps for the correct risk assessment are:

- Visual site inspection: for the correct detection of cyanobacteria blooms in site;
- Water sampling: Raw and treated water sampled, taking into account the cyanobacteria dispersion and the treatment process;
- Laboratory analyses including:
  - -Cyanobacteria identication through microscopic /molecular methods – to confirm the presence of potentially toxic species;
  - - Toxin quantification through immunological /chromatographic methods – to confirm toxin production.
- Risk evaluation: according to WHO guide lines and to both National (DL 306/2007) and European Directives (2006/7/CE) for water quality.

RESULTS & DISCUSSION

Tables below show frequencies of cyanobacteria and cyanotoxins detected in raw and treated waters from Portuguese reservoirs in different years. The frequency in which cyanobacteria occur varies greatly from year to year and water treatment is not always efficient in removing cyanotoxin from the water.

Raw water	1996	1997	1998	2002
W/O Cyanobacteria	0 %	3 %	0 %	6 %
< 10.000 cells per ml	9 %	6 %	0 %	65 %
10.000 – 100.000 cells per ml	91 %	35 %	35 %	14 %
> 10.000 cells per ml	0 %	56 %	65 %	14 %
Positive toxicity (microcistins)	22 %	9 %	97 %	7 %

Treated water	1996	1997	1998	2002
W/O Cyanobacteria	21 %	28 %	33 %	59 %
< 10.000 cells per ml	72 %	33 %	17 %	37 %
10.000 – 100.000 cells per ml	7 %	28 %	17 %	3 %
> 10.000 cells per ml	0 %	11 %	33 %	1 %
Positive toxicity (microcistins)	0 %	0 %	33 %	0 %

Graphs below show temporal variations in phytoplankton and cyanotoxins from one of the many freshwater reservoirs screened in this study. The seasonal dominance of cyanobacteria during warmer periods is not a general pattern since cyanobacterial blooms have been recorded during winter months in several reservoirs, same being persistent for the all year round. Cyanotoxin levels vary rapidly according to phytoplankton composition and cyanobacteria densities. Significant amounts of cyanobacterial cells are frequently observed in treated water samples.

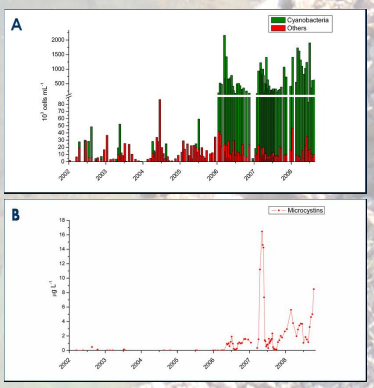


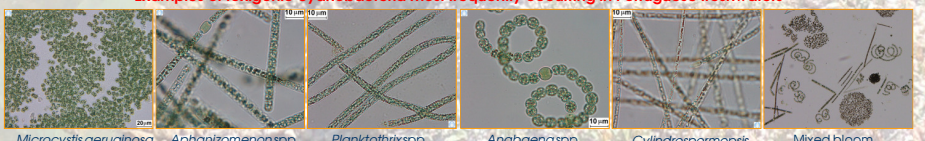
Fig. 3 – Phytoplankton density (A – raw water and C – treated water) and microcystins concentration (B) in a reservoir used for drinking water supply.

Although *Microcystis aeruginosa* seems to be the major species responsible for the toxic occurences detected, other bloom forming species such as *Anabaena* spp., *Aphanizomenon* spp., *Planktothrix spp.* and *Cylindrospermopsis raciborskii* have also been found with an increasing frequency. In some cases the cyanobacteria bloom communities are formed by a cocktail of cyanobacteria producing simultaneously different types of hepato and neurotoxins, in different quantities and at a different rates, with some strains being non-toxigenic (See Photos below).

CONCLUSIONS

- The unpredictable nature of cyanonobacterial blooms in what respects to their occurrence, their composition, their intensity and persistency, as well as to their overall toxicity, demands careful attention in assessing risks for human health.
- Global warming and increasing eutrophication of water resources pose new challenges to health and environmental authorities as these environmental changes are expected to favour cyanobacterial blooms and increase the frequency of invasive toxigenic species in temperate climates.
- Sistematic surveillance of freshwater reservoirs and adequate monitoring of water treatment facility processes are needed to prevent health risks from toxin exposure.

Examples of toxigenic cyanobacteria most frequently occurring in Portuguese freshwaters



Microcystis aeruginosa | *Aphanizomenon* spp. | *Planktothrix* spp. | *Anabaena* spp. | *Cylindrospermopsis raciborskii* | Mixed bloom

ACKNOWLEDMENTS

We thank all entities (health and environmental authorities, municipalities, water supplying companies) and concerned citizens for participating on the systematic survey of cyanobacteria and cyanotoxins in Portuguese freshwaters, both by detecting bloom problems in the field, communicating them to the National Health Institute and sending us field samples for laboratory analyses in the scope of the National Monitoring Program for Cyanobacteria.

We also thank the EUPHA committee for giving us the opportunity to present our results at the EUPHA – 2008 Lisbon's Meeting