Atalanta: The autonomous analytical algal toxin platform

I. Maguire1[1], J. Fitzgerald[1], B. Heery[1], C. Murphy[2], C. Nwankire[3], R. O'Kennedy[2], J. Ducrée[4] and F. Regan[1]

[1]School of Chemical Sciences, Dublin City University, Glasnevin, Dublin 9, Ireland
[2]School of Biotechnology, Dublin City University, Glasnevin, Dublin 9, Ireland
[3]Marine Environmental Sensing Technology Hub, Dublin City University, Glasnevin, Dublin 9, Ireland
[4]School of Physical Sciences, Dublin City University, Glasnevin, Dublin 9, Ireland

Cyclic peptide cyanobacterial toxins, in particular *Microcystis aeruginosa*, pose a serious health risk to humans and animals alike [1], [2]. Occurring mostly in fresh and brackish water, they have been identified to cause cancer promotion and liver damage [3]. Herein, we describe a portable, microfluidic-based system for *in-situ* detection of algal toxins in fresh water.

The Atalanta system is a novel, portable and sample-to-answer platform for the detection of toxic cyanobacteria – Microcystin-LR in fresh water. *Atalanta* utilises the partnership of highly-specific recombinant chicken anti-microcystin antibodies, prepared in-house, with a 3D-printed 'LASER-photodiode' fluorescent detection method, also developed in-house. A competitive immunoassay format is utilised to detect free toxin. Furthermore, dissolvable-film (DF) based flow-actuation facilitates full assay integration. This new approach will form the basis of a cost efficient, USB-controlled water quality monitoring system.

The *Atalanta* detection system consists of two components; the microfluidic *Atalanta* disc and the disc-holder. The *Atalanta* disc-holder was fabricated and assembled from a 3D-printed casing, with electronic components housed in device. The 5-layered microfluidic disc consists of five reservoirs, each with a separate ventilation, aligned radially with inter-connected microchannels. Each reservoir represents a functional assay step. First, microcystin conjugate is coated to the functionalised surface of the reservoir 3 prior to assembling the disc. A freshwater sample in reservoir 1 is pre-incubated with recombinant antibodies labelled with fluorophore (Alexa 647) in reservoir 2. This is then spun into reservoir 3 for detection through a competitive immunoassay using Microcystin-LR. Low fluorescence signal indicates high Microcystin-LR concentration in the sample.

Word count: 249 (max. 250 words)

References:

[1] C. MacKintosh, *et al.*, "Cyanobacterial microcystin-LR is a potent and specific inhibitor of protein phosphatases 1 and 2A from both mammals and higher plants," *FEBS Lett.*, vol. 264, no. 2, pp. 187–192, 1990.

[2] World Health Organization, *Toxic Cyanobacteria in Water: A guide to their public health consequences, monitoring and management*. 1999.

[3] J. M. Rinta-Kanto, *et al.*, "Lake Erie Microcystis: Relationship between microcystin production, dynamics of genotypes and environmental parameters in a large lake," *Harmful Algae*, vol. 8, no. 5, pp. 665–673, 2009.

Keywords: Microcystin, toxin detection, Microfluidics, Lab-On-A-Disc, LOAD, recombinant antibody technology, immunofluorescence detection, low cost diagnostic device