

Lumora - bioluminescent assays, courtesy of the firefly

Molecular diagnostics company Lumora provides portable testing devices that allow users to check rapidly and simply for harmful organisms, such as the bacteria that cause food poisoning. It makes use of the properties of the enzyme luciferase – which catalyses the reaction that produces the bioluminescent glow of the firefly. The technology at the heart of the device has multiple applications in clinical, environmental and nutritional testing, and has been licensed to global innovation company 3M for use in a food pathogen detection system.

Lumora Ltd. is a spin-out company of the Institute of Biotechnology at the University of Cambridge^{1,2}. It was set up in 2003 by Professor Jim Murray³ and Dr Laurence Tisi. Murray is now at the Cardiff School of



A glowing firefly. Credit: Herky/Wikimedia Commons

Biosciences, University of Cardiff, and Tisi subsequently became, and remains, the CEO of Lumora.

Early research into the application of bioluminescence for DNA testing focused on the development of a heat-stable form of luciferase, which later proved to be critical in the development of a system known as ‘bioluminescent assay in real time’ (BART). Initially, the work was begun by Murray in the laboratories of the University Of Cambridge Institute Of Biotechnology with the assistance of a post-doctoral researcher. In 2005 the company received support from BBSRC to further develop their assay technology.

The project was led subsequently by Tisi, who was funded by a three-year grant from BBSRC⁴. This enabled him, with others, to further improve the quantitative accuracy of the BART system in portable devices, which is required for a variety of applications such as determining the level of genetically modified material in agricultural products, as well as viral load determination in clinical applications.

“BBSRC didn’t fund the final stages of the work that led to the invention of BART, but the grant provided the conditions for it to happen. BBSRC was supporting Laurence Tisi when we initially thought about detecting specific DNA sequences with luciferase,” says Murray. “If he hadn’t been able to work on the project and had time to explore new ideas, Lumora would never have come about.”

Impact Summary

University of Cambridge spinout company Lumora Ltd has licenced it’s DNA testing technology to global innovation company 3M for use in a food pathogen detection system.

The technology relies on bioluminescence, using an enzyme from fireflies. BBSRC support enabled the researchers to develop the initial idea for detecting DNA sequences with luciferase.

The technology can be used to test for food-poisoning bacteria such as *salmonella* and *listeria*, as well as testing patients for viruses like HIV, and malaria parasites.



Portable Bioluminescent Assays in Real-Time (BART) instrument
Credit: Lumora Ltd

In 2012, Murray won the Commercial Innovator of the Year award from BBSRC for his work with Lumora⁵. This is because, among other benefits, the technology offers the developing world an affordable alternative to unavailable or impractical lab-based testing. For instance, in April 2013 Lumora partnered with The Foundation for Innovative New Diagnostics (FIND) to develop a diagnostic test that can be used in the developing world to identify people infected with the malaria parasite, even when the parasite is at very low levels in the patient's blood⁶. It could also help in the fight against HIV-AIDS, or improve water quality standards.

Shedding light on DNA detection

Lumora's BART technology 'reports' on the replication and re-copying of DNA sequences in real-time by causing light to be emitted in proportion to the amount of a specific DNA sequence present in the sample being tested. This makes the technology highly sensitive and specific. In its most recent form, the BART system is employed in a versatile hand-held device.

"BART technology represents the first of a new generation of assays which take advantage of the ability of bioluminescent enzymes to operate in excess of 60°C, a temperature at which most DNA detection needs to work," says Tisi. "BART bridges bioluminescent and molecular technologies in a unique



BART is a novel reporter system, exclusive to Lumora, used as a tool in molecular diagnostics. Credit: Lumora Ltd

way that offers a breakthrough in the simplicity and robustness of molecular assays."

Since 2004, Lumora has attracted several rounds of funding from business angels and institutions. This included Tate and Lyle Ventures in 2006, which enabled the company to move to its own premises in Ely, Cambridgeshire, to begin full-time operations and concentrate on developing the use of BART in tests for food-poisoning bacteria salmonella and listeria, which were successfully trialled in 2008 with an independent food pathogen reference laboratory. In the same year, Lumora entered into its first research partnership that ensured its future as a commercial operation.

Following another funding round with Catapult Venture Managers in 2011, it began concentrating on *in vitro* diagnostics in a clinical setting. Overall, the *in vitro* diagnostics market was valued at \$49.2Bn in 2012⁷.

Currently, Lumora employs 13 people – nine of whom make up a highly-experienced scientific team. As cofounder, Murray continues to have close ties with the company and its development, but is no longer a director.

Working in partnership

To fully exploit its intellectual property and expertise in bioluminescence, Lumora works in partnership with commercial and not-for-profit organisations in the fields of industrial microbiology and clinical diagnostics. In 2011 a food safety application based on the BART system was launched globally by 3M to which Lumora had licensed its technology.

"We now want to apply BART technology to a range of other diseases. The most obvious and most pressing need is HIV-AIDS. Patients need to be continuously tested for their viral loads so that their treatment dosage can be adjusted," says Murray. "At the moment, this requires laboratory facilities which are in short supply in Africa. We hope to create a device which can be used easily in those countries."

Notes and References

1. See: <http://www.lumora.co.uk>
 2. See: <http://www.biot.cam.ac.uk/administration>
 3. See: http://www.cardiff.ac.uk/biosi/contactsandpeople/stafflist/m-p/murray-jim-prof-overview_new.html
 4. Quantitative 'BART': Bioluminescent Assay in Real Time of nucleic acid amplification in simple handheld devices (BBSRC award details) <http://www.bbsrc.ac.uk/pa/grants/AwardDetails.aspx?FundingReference=BB%2fG017336%2f1>
 5. See: <http://www.bbsrc.ac.uk/news/people-skills-training/2012/120509-f-innovators-pt3-murray.aspx>
 6. See: <http://www.lumora.co.uk/index.php/news2/37-news/2013/102-lumora-to-partner-with-find-to-develop-new-high-throughput-malaria-molecular-diagnostic-test-for-use-in-the-developing-world>
 7. See: <http://www.marketsandmarkets.com/Market-Reports/ivd-in-vitro-diagnostics-market-703.html>
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