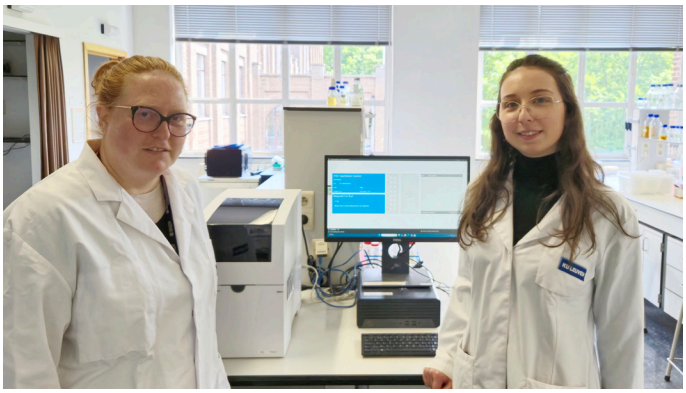
Agilent Case Study:
2100 Bioanalyzer and 4150 TapeStation systems

Phage-Driven Discoveries: Inspiration from Nature's First Bioengineers

Harnessing the power of bacteriophages at the KU Leuven Laboratory of Gene Technology

Discovered over a century ago, bacteriophages are among the most abundant and diverse entities on earth, holding great promise as antibacterial agents.[1] Phages have evolved to modify and control their bacterial hosts, evading bacterial xenogeneic silencing of their foreign DNA, subverting host gene expression, and co-opting host metabolism. Phage therapy, first launched in 1919, is back in the spotlight as an alternative treatment in the face of multidrug-resistant bacteria.[2] Furthermore, with bacterial infections threatening global food sources, bacteriophages have emerged not only as a means of combating infections in humans, but also as a tool for managing infections in key crop species.[1,3-5]

The Laboratory of Gene Technology at KU Leuven, led by Professor Rob Lavigne, is dedicated to elucidating these phage mechanisms to develop next-level synthetic biology tools, with research focused on human health and agricultural applications.



Lab staff at the Laboratory of Gene Technology at KU Leuven

"The goal of the division is to improve the welfare, health and productivity of individual living organisms. In our lab, we focus on searching for and characterizing bacteriophages, studying protein-protein interactions between the hosts and phages. We extract the tools that the bacteriophages are using for synthetic biology."

Alison Kerremans
Lab Technician
KU Leuven Laboratory, Department of Biosystems and Animal and Human Health Engineering Division

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Maintaining high standards in QC with less effort

The lab's research revolves around the analysis of diverse DNA and RNA samples from bacteria and bacteriophages. Cloning, PCR, and next-generation sequencing (NGS), performed using in-house nanopore sequencing and Illumina MiniSeq systems, make up much of the day-to-day work.

A vital component of the lab's processes is sample quality control (QC), which assesses DNA and RNA quality. RNA quality could be assessed on the Agilent 2100 Bioanalyzer system by the well-established RNA integrity number (RIN) score.

In 2023, the lab converted their 2100 Bioanalyzer instrument to the Agilent 4150 TapeStation system, significantly improving their QC workflow. The 4150 TapeStation is an economic, low-throughput system that provides quick, easy, and reliable analysis of nucleic acid samples for up to 16 samples per run. Ready-to-use Agilent ScreenTape devices minimize experimental preparation and sample consumption.

The TapeStation systems allow for the assessment of total RNA quality with the RNA integrity number equivalent (RIN^e) score. Additionally, the TapeStation systems enable the assessment of genomic DNA (gDNA) quality with the proprietary DNA integrity number (DIN) score, a metric not available on the Bioanalyzer instrument.

"We really like the system," Alison said. *"It is a good system for QC, allowing us to see DIN and RIN^e scores, as well as concentrations, at the same time."*

Alison continued, "The lab analyzes various samples from different bacteria, and isolation protocols can be very bacteria-specific, meaning that isolation techniques yielding high-quality DNA in one bacterial type may not yield high-quality DNA in another bacteria." Therefore, the lab relies on instrumentation and kits that allow them to assess and optimize isolation protocols to ensure that reads are of the quality and length required for successful sequencing.

For DNA analysis on the TapeStation system, the lab uses the Agilent D5000 ScreenTape assay, which facilitates accurate QC of PCR products and NGS libraries. However, one of their favorite assays is the Agilent gDNA ScreenTape assay. Analyzing and assessing gDNA enables the lab to optimize their extraction protocols, something that could not be done prior to implementing the TapeStation system. For RNA, the lab uses the Agilent High Sensitivity RNA ScreenTape assay, which has provided highly accurate and reliable results despite the low amount of RNA material available to load.

In addition to the value of the RIN^e and DIN scores, Alison also emphasized the benefit of the unique ScreenTape devices in minimizing sample contamination. Specifically, when it comes to DNase exposure, the ScreenTape devices excel due to their distinct, individual gel lanes and strict separation of sample and electrode pins. In contrast, the Bioanalyzer would require thorough cleaning after DNase exposure, as its electrode pins come into direct contact with the sample during electrophoresis.

Maximizing success in a small, dynamic lab

The Laboratory of Gene Technology is one of several labs within the department, and with limited size comes challenges. Often, the equipment needed for optimal research is expensive, and as Alison detailed, the labs rely on sharing equipment and devices with one another. "The struggle with this is that a lot of different people need to use your device, or you will need to train them." Alison emphasized, "We are not a company. People come and go very fast as they do their PhDs. So, from time to time, there are new people that need to be trained."

Therefore, in addition to producing reliable and accurate results, lab equipment must facilitate rapid and simplistic training to allow highly efficient onboarding of users at any level. Alison continued, "As a lab technician, I am responsible for the devices in our lab. So, for everyone who wants to use the equipment, I have to teach them how to use it."

One of the greatest benefits highlighted by the lab is the ease-of-use and accessibility of the TapeStation system. With new students and colleagues continuously rotating through the lab, trainability is key. Whereas sample and instrument preparation was more complex with the Bioanalyzer, the 4150 TapeStation system is easier to use. "I can really just show them the protocol. You mix your buffer with your sample in a tube, and you put the tube and the ready-to-use ScreenTape device into the machine," Alison noted. "I have a lot more time because of this."

Furthermore, Alison emphasized that a small lab must be able to efficiently run small sample numbers, as they won't have the throughput of larger labs. On the Bioanalyzer, users would often have to wait weeks to fill a single DNA or RNA chip. In contrast, Agilent ScreenTape devices can be reused, enabling the analysis of two or three samples at a time without wasting the remainder of the consumable or pausing research to wait for additional samples. ScreenTape components can also be ordered separately, without requiring the purchase of an entire kit.

Continuing to unlock the therapeutic potential of bacteriophages

The lab is committed to advancing its crucial bacteriophage research, focusing on developing therapies to combat infections, even against antibiotic-resistant strains. Beyond human therapies, studies on the benefits of bacteriophages in the agricultural industry are also taking off.

By harnessing the power of these highly diverse and adaptable biological entities through DNA, RNA, and protein analysis, the lab is also pioneering the development of novel synthetic biology tools with a wide range of future benefits.

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