**Cutting-edge chemistry**

**Shall I compare thee to a strand of DNA?**

*Using life’s data storage system to hold on to Shakespeare’s sonnets*

For billions of years DNA has been life’s data storage medium. Now, scientists have used DNA to code and store media and information, from all of Shakespeare’s sonnets to an audio recording of Martin Luther King’s ‘I have a dream’ speech.

‘If you stick a CD in a box ‘round the back of the sofa it’s good for a couple of years but it might not work three years later,’ explains Nick Goldman of the European Bioinformatics Institute, just outside Cambridge in the UK, whose team performed the work. ‘In 10 years’ time, when you take the box back out again, you might not even have a CD player anymore.’

**Long-term storage**

By contrast, DNA is long lived. Dried DNA can last for years, as Goldman explains: ‘They go drilling cores in Antarctica and they get bacteria out from 100 m down in the ice. They reckon those are millions of years old and they get DNA out of them.’ That stability, along with the increasing developments in DNA production and sequencing make the idea of using it for information storage an attractive option. As the costs of DNA reading and writing technologies come down, Goldman suggests that DNA might become the read-only medium of choice.

Even though we talk about the letters of DNA, there are only four bases (A, C, G and T), so there are not enough letters to spell out even a simple sentence. Instead, Goldman’s group converted data into binary code and then each byte was converted using various codes and information theory algorithms into a DNA sequence that was very information dense but avoided runs of the same base. ‘Both the writing and reading techniques are more prone to making mistakes if there’s a run of the same DNA base in a row,’ explains Goldman. ‘If you’ve got two or three or four As – adenines – in a row it’s harder to read that back exactly right.’

**Thinking differently**

Sriram Kosuri, who has also worked on using DNA to store information, says that the value of this work is that it gets people to think differently about data storage. ‘We’re reaching a limit on how much we can store on a surface,’ he explains, mentioning the current world record of a 12 atom transistor. The final solution might not be DNA, but another polymer that’s easier to read and synthesise and less prone to enzymatic digestion. ‘We’re using DNA in its rawest form, but I think in the future we can imagine using something very different,’ he concludes.

*Laura Howes*

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The World Health Organization estimated that in 2010 there were 219 million documented cases of malaria. That year, approximately 660,000 people died from the disease. In Africa, a child dies every minute from malaria.

A new class of antimalarial drugs that is effective across various stages of the malaria parasite’s lifecycle has been developed by an international research team. Early indications also show that it may take longer for the parasite to develop resistance to the new molecules than it has for existing drugs targeting the same pathway.

Malaria is a devastating disease worldwide, and the ability of the Plasmodium family of parasites that cause the disease to develop resistance to drugs leads to a constant arms race for new medicines.

Michael Riscoe’s group at the Oregon Health and Science University, US, is part of a large international collaboration pulled together by the Medicines for Malaria Venture. The group has developed a new antimalarial compound that can kill the malaria parasite at several different stages of its lifecycle.

‘ELQ-300 targets the parasite mitochondrion,’ Riscoe says. In most organisms, the primary function of the mitochondria is to produce energy by making adenosine triphosphate (ATP). ‘But in the parasite, the primary function is to produce the pyrimidine building blocks for DNA [thymine and cytosine].’ The molecule prevents the synthesis of those bases, which prevents the parasite from reproducing, so it dies.

‘When an infected mosquito bites a human, she will inject maybe a dozen sporozoites into the bloodstream,’ Riscoe says. These immature versions of the parasite go to the liver, where they replicate and develop before being released into the blood. The parasites then reproduce both by division and by producing the sexual forms, or gametocytes. The gametocytes are the only form of the parasite that can survive in the gut of a mosquito that bites an infected person, and go on to transmit infection to a new host. ‘The parasite is reproducing at every stage in the infection process, so ELQ-300 can target all of these stages,’ Riscoe adds.

**Blast from the past**

ELQ-300 contains a quinolone ring system and a diaryl ether side chain. Riscoe explains that a quinolone called endochin was first identified as an antimalarial in the 1940s. It could both treat and prevent malaria in birds, but failed in humans because it was metabolised very quickly. To get around this, Riscoe’s team took a cue from a class of pyridone-based drugs with a similar mode of action that pharma company GlaxoSmithKline (GSK) was investigating. These included diaryl ether groups, which the team found greatly improved the metabolic stability of their compounds.

Riscoe points out that, unfortunately, GSK’s pyridone drugs failed in clinical trials as they were toxic. Using a quinolone, which has an extra benzene ring tacked on the side, seems to get around that problem.

**Phillip Broadwith**

**New antimalarial drug resists resistance**

**Scientists draw on past failures to address toxicity problems**