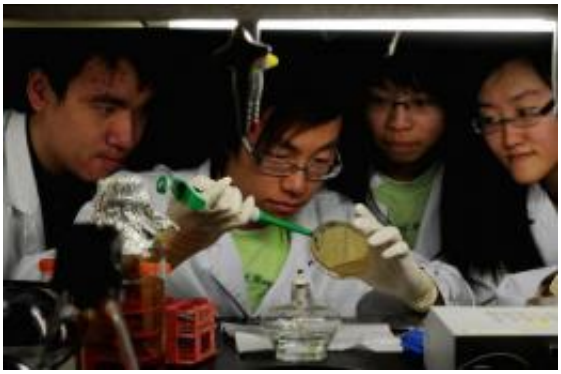
Hong Kong researchers store data in bacteria

January 9 2011, by Judith Evans



Biochemistry students from the School of Life Sciences at The Chinese University of Hong Kong (CUHK) show bacteria growing in a petri dish in Hong Kong. The group is making strides towards storing such vast amounts of information in an unexpected home: the E.coli bacterium better known as a potential source of serious food poisoning.

The US' national archives occupy more than 500 miles (800 kilometres) of shelving; France's archives stretch for more than 100 miles of shelves, as do Britain's.

Yet a group of students at Hong Kong's Chinese University are making strides towards storing such vast amounts of information in an unexpected home: the E.coli bacterium better known as a potential source of serious food poisoning.

"This means you will be able to keep large datasets for the long term in a box of bacteria in the refrigerator," said Aldrin Yim, a student instructor

on the university's biostorage project, a 2010 gold medallist in the Massachusetts Institute of Technology (MIT)'s prestigious iGEM competition.

Biostorage -- the art of storing and encrypting information in living organisms -- is a young field, having existed for about a decade.

In 2007, a team at Japan's Keio University said they had successfully encoded the equation that represents Einstein's theory of relativity, E=MC2, in the DNA of a common soil bacterium.

They pointed out that because bacteria constantly reproduce, a group of the single-celled organisms could store a piece of information for thousands of years.

But the Hong Kong researchers have leapt beyond this early step, developing methods to store more complex data and starting to overcome practical problems which have lent weight to sceptics who see the method as science fiction.

The group has developed a method of compressing data, splitting it into chunks and distributing it between different bacterial cells, which helps to overcome limits on storage capacity. They are also able to "map" the DNA so information can be easily located.

This opens up the way to storing not only text, but images, music, and even video within cells.

As a storage method it is extremely compact -- because each cell is minuscule, the group says that one gram of bacteria could store the same amount of information as 450 2,000 gigabyte hard disks.

They have also developed a three-tier security fence to encode the data,

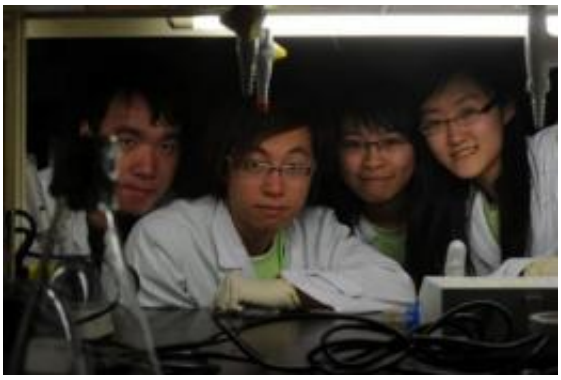
which may come as welcome news to US diplomats who have seen their thoughts splashed over the Internet thanks to WikiLeaks.

"Bacteria can't be hacked," points out Allen Yu, another student instructor.

"All kinds of computers are vulnerable to electrical failures or data theft. But bacteria are immune from cyber attacks. You can safeguard the information."

The team have even coined a word for this field -- biocryptography -- and the encoding mechanism contains built-in checks to ensure that mutations in some bacterial cells do not corrupt the data as a whole.

Professor Chan Ting Fung, who supervised the student team, told AFP that practical work in the field -- fostered by MIT, who have helped develop standards enabling researchers to collaborate -- was in its early stages.



Biochemistry students from the School of Life Sciences at the Chinese University of Hong Kong (CUHK), seen here posing for a picture. The group is making strides towards storing vast amounts of information in an unexpected home: the E.coli bacterium better known as a potential source of serious food poisoning.

But he said: "What the students did was to try it out and make sure some of the fundamental principles are actually achievable."

The Hong Kong group's work may have a more immediate application.

The techniques they use -- removing DNA from bacterial cells, manipulating them using enzymes and returning them to a new cell -- are similar to those used to create genetically modified foods.

But rather than changing the building blocks of an organism, the Hong Kong group allows extra information to piggyback on the DNA of the cell, after checking their changes against a master database to make sure they do not have accidental toxic effects.

Their work could enable extra information to be added to a genetically modified crop in the form of a "bio barcode", Chan said.

"For example, a company that makes a GM tomato that grows extra large with a gene that promotes growth -- on top of that we can actually encode additional information like safety protocols, things that are not directly related to the biological system."

Other types of information, like copyright and design history, could help to monitor the spread of GM crops, he said.

"It's kind of a safety net for synthetic organisms," said Wong Kit Ying, from the student team.

Beyond this, Chan and the students are evangelical about the future possibilities of synthetic biology.

"The field is getting popular because of the energy crisis, environmental pollution, climate change. They are thinking that a biological system will be a future solution to those -- as alternative energy sources, as a remedy for pollution. For these, micro-organisms are the obvious choice," Chan said.

One type of bacterium, Deinococcus radiodurans, can even survive nuclear radiation.

"Bacteria are everywhere: they can survive on things that are unthinkable to humans. So we can make use of this," Chan said.

So is it possible that a home computer could one day consist of a dish filled with micro-organisms?

The group dismisses concerns that this could be dangerous, pointing out that despite E.coli's poor reputation, they use an altered form that cannot exist outside a rich synthetic medium.

In fact, says Chan, while safety rules are strict, more measures are taken to protect the bacteria from contamination than to protect the researchers from the bacteria.

However, Yim admitted that while the group's work is a "foundational advance", a petri dish PC is not likely to be on the market in the coming years, not least because the method of retrieving the data requires experts in a laboratory.

"It's possible," he said, "but there's a long way to go."

from https://phys.org/news/2011-01-hong-kong-bacteria.html