NTU scientists invent superbug killers

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The superbugs have met their match. Conceived at Nanyang Technological University (NTU), it comes in the form of a coating which has a magnetic-like feature that attracts bacteria and kills them without the need for antibiotics.

The killer coating, which has shown to destroy 99 per cent of the bacteria and fungi that it comes in contact with, is now being used by two companies: a contact lens manufacturer and a company specialising in animal care products.

The next step is to extend its use in a wide range of biomedical and consumer products, ranging from implants and surgical instruments to kitchen utensils and cutlery, as it is harmless to human cells.

This is an alternative solution which could replace antibiotics - currently the main defence against bacteria - now powerless against super bugs.

The brainchild of Professor Mary Chan, Acting Chair of NTU's School of Chemical and Biomedical Engineering, the coating made from Dimethyldecylammonium Chitosan methacrylate has earned a place in the prestigious international journal, Nature Materials.

This "sponge-like" polymer holds a positive charge, which acts as a magnet-type of force to draw in bacteria which has a negative charge on their cell walls. When the bacterium comes in contact with the coating, the cell walls are 'sucked' into the nanopores, causing the cell to rupture, thus killing the bacterium.

"The coating can also be applied on biomedical objects, such as catheters and implants to prevent bacterial infections, which is a serious cause of concern as many bacteria are now developing resistance to antibiotics - currently our main source of treatment for infections," Prof Chan said.

"By developing novel materials which uses physical interaction to kill bacteria cells, we envisage this can be an alternative form of treatment for bacterial infections in the near future."

Superbugs which had fallen prey to the coating include Pseudomonas aeruginosa, which can cause infections in the upper respiratory tract, gastrointestinal tract and the urinary tract; and Staphylococcus aureus, which can cause infections ranging from skin boils or abscesses to deadly diseases such as pneumonia and meningitis.

This research for a broad-spectrum antimicrobial coating was first sparked off by Prof Chan wanting to find an effective way to combat bacteria and fungi on contact lenses which could cause corneal infections (microbial keratitis) that could lead to permanent visual damage.

According to a 2006 study, the estimated annual incidence of a common fungi corneal infection, Fusarium keratitis, related to contact lens wear in Singapore is 2.35 per 10,000 wearers.

Building on the success of the antibacterial coating, Prof Chan and her doctoral student, Mr Li Peng, have now succeeded in making another broad-spectrum antimicrobial solution of a similar kind which is highly selective, killing off only bacteria and fungi without harming human cells In vitro.

Their research was published recently in a leading journal, *Advanced Materials*. This liquid material based on cationic antimicrobial peptidopolysaccharide, is a polymer which is attracted to microbial cell

walls. When the two come into contact, the integrity of the cell wall is disrupted which leads to its rupture and death.

As this novel material kills cells via the destruction of cell walls, it makes it extremely difficult for bacteria to develop an effective resistance.

Prof Chan hopes to further develop this solution into topical applications such as cream and lotions, which can be used to disinfect and treat serious or chronic wounds such as lesions suffered by diabetic patients, killing any bacteria present that are resistant to antibiotics.

"Our long term goal is to develop this into an ingestible form, so it can effectively treat bacterial infections within the body, such as pneumonia and meningitis, replacing antibiotics as the standard treatment." she added.

The two antimicrobial prototypes - the coating and the liquid solution - took a total of five years to research and costs over $800,000 to develop.

Prof Chan now aims to improve the liquid solution by developing it into a safe and proven antibiotic replacement within the next five years as the demand for such alternatives will be even higher with the rapid emergence of superbugs.

Provided by Nanyang Technological University