Creation of synthetic life to happen within two years

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Scientists are on the brink of creating the first complex artificial life after painstakingly building more than a third of an organism's DNA from scratch.

Fully synthetic baker's yeast, which is said to be only one or two years away, will be a powerful tool for bio-engineers to grow fuels and medicines with much greater speed and efficiency than they can with conventional gene modification technology.

It also clears the way for researchers to build more advanced life forms, including roundworms, plants and ultimately human cells.

Seven years ago an American team, led by the geneticist Craig Venter, assembled the first living bacterial genome out of individual pieces of DNA. The yeast project, however, is a far bigger technical challenge, with scientists on four continents piecing together ten million letters of the DNA of yeast over 16 blocks of genes known as chromosomes.

Biologists have been able to delete and tweak DNA for two and a half decades but the process remains laborious and sometimes unpredictable. When it goes wrong it can take months of work to determine where a genetic error is hiding.

The yeast project, called the international Sc2.0 consortium, will revolutionise this field, according to its founder, Yizhi "Patrick" Cai, from the Wellcome Trust Centre for Cell Biology at the University of Edinburgh.

"The idea is that you build to understand," he said. "We want to build something which is more stable and more amenable for engineering. We have complete control over rewriting the code of the yeast."

Dr Cai and his colleagues have built sections of DNA that are 30,000 letters long by chemically gluing one molecule to another. These sections are then slotted into a living yeast cell to find out whether they are viable. If there is a problem, it can be identified and fixed within hours.

The team have now built six of the yeast's 16 chromosomes, which are described in papers published in the journal *Science*. The synthetic genome is 8 per cent shorter than its natural state, with many of its repetitions and unnecessary strings excised and with improvements added.

These include a DNA sequence that will allow the yeast to build a wider range of proteins, as well as a piece of genetic code called Scramble, which gives scientists the power to reshuffle or swap genes in dozens of permutations at once so that the modified strains can face off in what Dr Cai calls an evolutionary "cage fight". The researchers can then simply pick the most successful strain at the end of the experiment and copy its code.

Sc2.0, which is named after *Saccharomyces cerevisiae*, the Latin name for baker's yeast, is a sister scheme to Human Genome Project-Write, which aims to do for humans what Dr Cai's consortium is doing for microbes.

The goal is to give medical scientists the ability to make detailed manipulations to human cells so that they can model cancer and other diseases and work out their weak points.

"The potential for biomedicine is enormous," Dr Cai said. "You could get a much better understanding of human diseases."

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