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# Demonstrating the origin of a species

By Dick Ahlstrom, Science Editor

**The work of Trinity College researchers shows how a new species can evolve by accident - giving us bread and wine in the process, writes Dick Ahlstrom**

A major genetic error about 100 million years ago helped deliver the yeast species that allows us to enjoy bread and wine. A study by researchers at Trinity College Dublin of this big mistake has also taught us a great deal about how different species can arise.

The research is published this morning in the prestigious journal, *Nature*. It describes how a progenitor yeast species living about 100 million years ago mutated by producing an extra copy of its entire genome.

The result was a collection of new yeast species including the important *Saccharomyces cerevisiae*, the yeast used to make bread and wine, explains Trinity's Smurfit Institute of Genetics professor, Ken Wolfe.

This is the first time that this type of species formation or 'speciation' has been demonstrated, says Prof Wolfe.

"It teaches us something about the process through which new species can be formed.

"That is one of the most difficult things to understand in genetics."

An organism evolves by gaining or losing genes, the working parts of their genetic blueprint, Prof Wolfe explains. If genes are duplicated they tend to get dropped as the extra copies aren't required.

These genome changes either help the organism to survive, thus increasing the chances they will be passed along to the next generation, or work against survival and cause the organism to die off. That is evolution in a nutshell.

The progenitor yeast all those years ago took the dramatic step however of duplicating its entire genome, leaving it with a double copy of every gene.

This isn't necessarily a rare thing, adds Wolfe. "It is very common in the plant kingdom. Virtually every flowering plant has experienced a doubling of its genome," he says.

Most honey fish also arose as a result of a genome-doubling event that occurred in an early fish.

"Because the genome was duplicated there were many, many (gene) losses. We found that this process of losing genes occurred very quickly," he explains.

They tracked the gene changes across three related yeast species which included *S. cerevisiae*, *S. castellii* and *Candida glabrata*, whose genomes are already known in detail.

Team member Kevin Byrne developed a special software programme for finding genome changes across these three species. Colleague Devin Scannell did the gene pattern analysis and Jonathan Gordon was a co-author on the research.

It all has to do with the order of the genes, Prof Wolfe says.

“We get these very well-conserved patterns. We look for places in the genome where genes are missing.”

As the offspring of the progenitor yeast continued to evolve they lost different duplicate genes. Eventually these differences became more important because they created fertility barriers between the lineages.

Successful mating could occur between two yeast cells that had lost the same sets of genes, Prof Wolfe says.

The offspring of yeasts that lost different sets of genes would be infertile because their “grandchildren” were left with incomplete genomes.

Once the process started the three groups separated into species fairly quickly due to “reproductive isolation” Prof Wolfe’s team found.

The results confirmed a theory first proposed in 1909 by the great Gregory Bateson of Cambridge University, who invented the terms genetics.

He theorised that new species could emerge by the simple process of losing unnecessary extra gene copies, making this proposal look before scientists had learned about DNA’s structure.

“He was working completely from a theorist’s point of view,” says Wolfe.

Now Prof Wolfe has provided the experimental results in support of Bateson’s theory.

“This is really the first confirmation that this proposal can create new species,” he says.

The process is also noteworthy because it does not require an active intervention in the genome. “It shows a passive mechanism can create fertility barriers between species,” Prof Wolfe says.