

is it safe to convict?

Guest Feature



DNA Evidence: is it safe to convict?

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In recent years the identification of criminal suspects by forensic DNA evidence has become common place. The general public believes such evidence to be infallible. Juries find it so beyond reasonable doubt that most defendants will plead guilty when confronted with it.

That reputation has been achieved by exploiting public ignorance and reinforced by regular doses of misinformation disseminated by the law enforcement community. This article aims to draw attention to a hitherto unpublicised weakness in the standard DNA identification technology currently in use by law enforcement agencies throughout the world.

The technology relies on the amplification of sections of DNA called Short Tandem Repeats (STRs) with commercially manufactured Polymerase Chain Reaction (PCR) kits. The identification of individuals by PCR/STR is called DNA profiling, typing or fingerprinting.

The FBI's CODIS database contains thirteen 'core' STR loci while Britain's Forensic Science Service database contains ten. Several multiplex PCR kits are designed to amplify those particular sets of STR loci in a single reaction.

Each STR locus represents a section of DNA, half of which is inherited from each parent. Each of those halves is called an allele. At every STR locus an individual has two alleles. The distinguishing feature of an allele is that it exists in several known lengths. The thirteen 'core' STR loci yield twenty-six alleles. Individuals can be identified to a high degree of probability by measuring the lengths of those alleles.

STR alleles are very, very small sections of DNA. Compared to the three billion base-pair length of an individual's DNA (i.e. genotype), a profiling allele is between 100 and 450 base pairs in length.

The number of alleles (i.e. fragment lengths) observed across all thirteen CODIS STR loci is around 344 as of 2001 (while rare alleles continue to be discovered).

That means that every individual on the planet has some combination of 26 alleles, all of which belong to a pool of about 344 known alleles. In other words, with just 344 alleles, one can create the DNA profile of any individual on earth (some very rare exceptions acknowledged).

It is here that the supposed infallibility of criminal DNA profiling technology falters: an allele is nothing more than a fairly short molecule carrying a particular sequence of DNA bases. Such molecules are used extensively in biotechnology where they are called DNA probes or primers. They are so important that a huge industry has arisen to manufacture and supply custom designed probes and primers to research laboratories all over the world. Those artificially created fragments of DNA are virtually indistinguishable from STR allele molecules.

The base-pair sequences (including outside markers) of the CODIS STR allele molecules are published on several online STR databases. Any of those molecules can be ordered online from dozens of biochemical supply companies for a few dollars per section. It is easy to splice together sections of up to seventy base pairs in length to create a complete allele molecule.

Anyone with a few hundred dollars to spend, a little know-how and a well-equipped kitchen can isolate and purify most of the observed allele molecules with relative ease from cigarette butts taken from public ashtrays. Smokers leave traces of their DNA on every filter tip. (The British government recently announced legislation to make surreptitious DNA specimen collection illegal.)

Amplification of the DNA is done with a ready-to-use PCR kit by cycling test tubes between hot and cold water baths for a couple of hours. The isolation technology is similar to that required to electrolyse water and separate different coloured dyes with damp blotting paper - most high school students could do it.

A more sophisticated allele collector can purchase a fully automated, desktop Nucleic Acid Synthesiser that will manufacture any STR allele molecule on demand. (A second-user DNA synthesiser currently sells for around US\$10,000.) Such machines are usually installed in forensic laboratories.

When juries convict on DNA profiling evidence, British courts can impose the life sentence while US courts can impose the death penalty.

Should juries be so quick to convict when any college-level biology student, dishonest policeman or cunning perpetrator could have fabricated a suspect's DNA profile from a handful of discarded filter tips? One would hope not.