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In recent times as more technological advances are made, newer gadgets and methodology are introduced to the forensic science world. An example would be the Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR) - CRISPR-associated protein 9 (Cas9) which is a genetic engineering technique in molecular biology that utilises an enzyme in tandem with a modified CRISPR sequence to selective target DNA sequences and alter the sequences within DNA. This genome editing technique has a myriad of applications including treatment of cancer and other some previously incurable diseases.

In the field of forensic science, the applications of this genome editing technique would be more focused on its ability to selectively target DNA sequences. It is possible to identify a person from their DNA profile due to DNA polymorphism, the difference or variation in DNA profile between individuals. The use of Short Tandem Repeats (STR) of loci in DNA profiling can provide evidentiary value to match the trace DNA found at a crime scene to an individual or their relatives. Most methods for obtaining the DNA sequence from trace DNA use methods such as Polymerase Chain Reaction (PCR) to amplify it and generate a sufficient amount for testing and development of a DNA profile. Recently on 25 March 2019, a paper was released describing a method utilising CRISPR-Cas9 with a graphene-based biosensor that allows for the development of a DNA profile without the need for amplification.

Instead of “cutting” and altering the genome of the given trace DNA, the Cas9 proteins were reprogrammed and modified to search for specific matching DNA sequences and bind to them. In the process of binding to the matching DNA sequences, the electrical conductivity of the surface of the graphene-based biosensor is changed. These changes are monitored in real-time by the chip that sends a signal to a portable handheld reader that allows for the generation of a DNA profile. This innovative chip allows for the fast generation of a DNA profile from the trace DNA found at a crime scene on site.

The generated DNA profile can then be compared to others in national DNA databases, such as the Combined DNA Index System (CODIS), to provide the identities of the possible suspects. However, the DNA profile could end up unmatched with the other profiles in the database if the suspect's DNA was not previously recorded. In this situation, DNA phenotyping would be of tremendous help to the investigation compared to the conventional DNA profiling method. DNA phenotyping refers to the prediction of physical features of possible suspects through the use of known single nucleotide polymorphisms (SNP) and predictive modelling.

Recently, a new forensically validated Forensic DNA Phenotyping (FDP) system, the HIrisPlex-S DNA test system, was introduced that allows for the prediction of the most probable hair colour, eye colour, and skin colour of individuals from the given genotype. It was further developed from its predecessor, HIrisPlex DNA test system, that allowed for the prediction of only hair colour and eye colour.

Utilising known SNPs linked to the pigmentation of the hair, eyes, and skin from databases in multiplex assays, it is possible to generate possible matching pigmentations results. The results are then used in three statistical prediction models to generate the most probable hair colour and eye colour and the two most probable skin colours to account for tanning and other variations. This FDP system has complied with the guidelines of the Scientific

Working Group on DNA Analysis Methods (SWGDAM) and became the first forensically validated tool for skin colour prediction.

Law enforcement can then use the resulting data to narrow down the pool of possible suspects or even give a lead on a possible suspect. Besides the introduction of innovative devices that aids in the investigation and identification in criminal cases, a change in methodology could lead to a new approach or outlook in forensic investigation and research.

Recently in September 2020, the Misuse of Drug Act (MDA) was amended to include three new groups of synthetic cannabinoids to tackle the issue of New Psychoactive Substances (NPS). Designer drugs are controlled substances that mimic the effects of controlled drugs while avoiding detection by modifying the parent drug chemical structure. Synthetic cannabinoids are designer drugs that mimic the effects of cannabis.

A new synthetic cannabinoid, APP-BUTINACA, was recently detected in Singapore last year (January 2020). However, as typical synthetic cannabinoids are heavily metabolised in the body after consumption, they are incredibly difficult to detect in urine drug tests. Thus, some researchers from NUS employed a new approach to screen for the new synthetic cannabinoid. Rather than looking for the presence of the parent drug or its metabolites in urine samples, the researchers used human liver enzymes to synthesise metabolites of the drug and successfully identified 15 metabolites, as well as their respective pathways of biotransformation within the body. It was decided that 3 of these metabolites will be utilised as biomarkers for the new synthetic cannabinoid due to their atypically larger presence in urine samples after consumption of the drug.

This unconventional methodology can also be further applied to other existing and future synthetic cannabinoids to identify their respective urine biomarkers to combat drug trafficking.

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