



A82 Pyrosequencing Analysis of DNA Labeled Security Ink

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After attending this presentation, attendees will have learned about the possibilities to analyze DNA from bank notes stained with ink and DNA using a rapid extraction method, a PCR, and then a pyrosequencing assay. The pyrosequencing will reveal the unique DNA tag connected to a specific lot of bank notes or cassette. The analysis procedure, results, deciphering for control samples, and case work samples will be discussed. The use of DNA labeling for other items of value as art, perfume, clothing, and documents will also be discussed.

This presentation will impact the forensic science community by providing information regarding security labeling and the required DNA analysis to identify labeled items. This is of great value for labeling of cash-in-transit by incorporation of a unique DNA tag into the ink. As robberies of cash-in-transit are common in Sweden, this system will impact the handling of these cases and potentially prevent robberies. These issues will be discussed in more detail.

It is important to have systems and methods for security marking and protection of valuable property regardless of the material. Security marking is especially interesting when it comes to cash in transit and ATM machines where vast amounts of money are often handled. One method is to stain the money with either ink dye or dye and smoke. A further step is to add unique synthetic DNA tags that are invisible to the eye. DNA-tagged stolen money can then be traced back to its original location. This system is well developed and is already used in many countries in Europe.

Trace Tag, Inc. has developed the unique tags as well as an assay for analysis of the tags. The DNA tags consist of short synthetic oligonucleotides with a specific section for analysis purpose, and a variable section providing the unique tag sequence. Since there are billions of codes available it enables a unique link between a stained item and a security box, owner, or ATM machine. Moreover, the tags are totally invisible, cannot be replicated or counterfeited and can only be analyzed in authorized laboratories. These features allow analysis of individual bank notes that can be performed rapidly to assist the law enforcement in robbery investigations.

The analysis procedure is robust and user friendly. In short, the DNA tag is extracted from the note, the extract is amplified using PCR, and the short DNA sequences are determined by pyrosequencing technology. Pyrosequencing is a fast and easy to use sequencing by synthesis method that can run up to 96-samples in less than an hour. The method was first developed for high throughput SNP analysis, but is also suitable for medium throughput SNP typing or sequencing of shorter stretches of DNA. Pyrosequencing technology has previously been utilized successfully for mtDNA sequencing and autosomal STR- and Y-STR analysis of forensic samples in our laboratory. The pyrosequencing data from the DNA-tagged material from each bank note is sent to Trace Tag International (TTI) in UK, where a database is used for identification of the unique code and the serial number of the sequence. The code is thereafter submitted to 3SI security systems, in Belgium, which identifies the customer (bank, security company, or others), the location, and the installation of the unique DNA tag.

Successful analyses of unique DNA tags by pyrosequencing analysis, and the subsequent identification through TTI and 3SI, show that tracing bank notes back to specific cash in transit boxes or ATM machines and their staining device is an efficient way to conquer crime. This labeling system and identification assay will thus provide an asset to overall security and has the potential to be applicable on a larger scale in a near future. The system can also be applied for invisible labeling of a large variety of additional items of value such as paintings, brand clothing, passports, documents, perfume, and much more. This will allow increased security in general and possibly prevent crimes. In addition to the possibility to actively trace valuable items or cash back to owners or banks, the information about DNA labeling can deter attacks, e.g., cash in transit vehicles.

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