B76 Enzymatic Cascades for Biochemical Identification From Sweat

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After attending this presentation, attendees will better understand that sweat is a complex, non-invasive, biological fluid capable of discriminating between multiple individuals based on the respective concentrations of biochemical content in the sweat of each individual.

This presentation will impact the forensic science community by providing a new method and purpose for sweat analysis that is capable of differentiating metabolic compounds inherent in each individual's sweat. This presentation will demonstrate the potential of sweat analysis for biochemical identification purposes to increase security measures by serving as a locking mechanism for electronic devices. Future research into sweat analysis will also create an alternative to the time-expensive DNA identification processes via the bio-affinity detection of small molecules in sweat.

Sweat is a non-invasive, biological fluid that is continuing to attract attention by the scientific community as it contains various amino acids and other low molecular-weight compounds. The concentrations of the biochemical content within an individual's sweat are controlled by hormone metabolism processes that are variable and fluctuate daily based on factors such as age, gender, diet, and activity levels. Therefore, no two individuals will have the same hormone levels at a given time and the concentrations of these sweat components should be specific to each individual; however, the limitation of instrumental detection limits prevents the determination of an individual based on a single analyte. By monitoring multiple analytes, the probability of correctly identifying a person based on these metabolic analyte concentrations increases. The combination of these levels has the potential to increase security measures by serving as a locking mechanism for electronic devices containing personal information, such as smartphones and tablets, and are much more difficult to duplicate than current security measures.

Three compounds commonly found in sweat and fingerprints were studied using three separate and respective single-analyte enzymatic assays for the analysis of sweat by ultraviolet-visible spectrophotometry. The separate use of all three methods has the ability to determine the concentrations of each compound within the sweat of the sample originator. Analysis was first performed on 50 mimicked sweat samples that were created and tested based on the physiological concentrations of amino acids and small molecules known to be present in sweat. Additionally, a collection and extraction method was successfully developed in order to collect and test authentic sweat samples from volunteers. The use of similar enzymatic assays has been previously demonstrated when analyzing fingerprints. Since the amino acid content was sufficient for authentic fingerprint detection, the amino acid content in authentic sweat should be the same, if not greater. The application of sweat collection was designed to decrease the sampling error, as compared to fingerprint collection, and increase the amount of sweat collected to aid in the analysis of small molecules at low concentrations.

Biomarker analysis is a well-established discipline in forensic science that involves the analysis of biological samples for the presence of various substances indicative of personal attributes, such as the identification of an individual through DNA in blood. Although the forensic science field has developed rapidly over the years, the investigation processes are lengthy and the majority of the routinely used forensic science techniques require proper sample collection at the crime scene, followed by transportation to a laboratory facility before any informative analyses. This has led to a backlog in the analysis of serology samples. The research presented here addresses this situation by introducing the use of bio-affinity-based assays for quick and straightforward analyses of sweat. Because only miniscule amounts of enzymes and substrates are necessary, this method only requires very small amounts of samples and can be developed into a field kit for on-site testing. Furthermore, the bio-affinity-based cascades are remarkably versatile and can be adjusted for the analysis of a wide range of substrates. By utilizing re-programmable bio-affinity-based cascades, this approach has the potential to create a new method for identification, which can decrease crimes through increased security measures and move the strictly laboratory-based analyses to rapid on-site analyses that do not require specialized laboratory training. This could lead to the revolution of the field of forensic science and result in the acceleration of many criminal investigations.

Identification, Sweat, Cascades