IDENTIFICATION OF FORENSICALLY RELEVANT BODY FLUIDS USING A PANEL OF DIFFERENTIALLY EXPRESSED MICRORNAS

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Serological methods routinely used in forensic casework for the identification of biological fluids possess varying degrees of sensitivity and specificity. Currently none of the routinely used testing can confirm the presence of saliva, vaginal secretions or menstrual blood. The lack of specificity and the time and labor required to perform the serology-based testing has resulted in a trend to bypass conventional body fluid identification methods and proceed straight to the analysis of DNA present in forensic samples. However, the identification of the tissue or fluid of origin of biological stains is often crucial to criminal investigations. Therefore, there is a need for the development of suitable molecular genetics based body fluid identification methods that are fully compatible with the current DNA analysis pipeline and that can positively confirm the presence of biological fluids. Recently the use of messenger RNA (mRNA) profiling has been proposed to supplant conventional methods for body fluid identification. However, the size of the amplification products used in these mRNA assays (~200-300 nt) may not be ideal for use with degraded samples frequently encountered in forensic casework.

Recently, there has been an explosion of interest in a novel class of small non-coding RNAs, microRNAs (~20-25 bases in length), with numerous reports of tissue- specific miRNAs. In order to determine if body fluid-specific miRNAs could be identified, we performed the first comprehensive evaluation of miRNA expression in dried, forensically relevant biological fluids (blood, semen, saliva, vaginal secretions and menstrual blood). While no truly fluid-specific miRNAs were identified, we have identified a panel of nine miRNAs, including miR451, miR16, miR135b, miR10b, miR658, miR205, miR124a, miR372 and miR412, that are differentially expressed to such a degree as to permit the identification of the body fluid origin of forensic biological stains using as little as 50pg of total RNA. The miRNA based body fluid identification assays were highly specific since the miRNA expression profile for each body fluid was different from that obtained from twenty-one human tissues. The assays were sensitive and specific enough to identify the biological fluid in aged, environmentally compromised and in simulated casework samples. The results of this study provide an initial indication that miRNA profiling may provide a promising alternative approach to body fluid identification for forensic casework.