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GC×GC-TOFMS FOR FORENSIC BLOOD VOC PROFILING

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The detection of blood at a crime scene can provide critical information about the nature of events that occurred, the order of events, and possibly the identity of the individuals involved. Therefore, the detection of blood has always been an important aspect of forensic investigations. Establishing an accurate volatile organic compound (VOC) profile of blood can assist with developing and improving existing forensic methods to locate blood. This can be relevant at a crime scene or may also apply to the search for living and deceased individuals using scent-detection canines or portable detection devices. In recent years, the possibility to train scent-detection canines on blood has become more popular by forensic agencies. In order to provide more information about such applications, comprehensive two-dimensional gas chromatography (GC×GC) coupled to time-of-flight mass spectrometry (TOFMS) has been proposed as a novel analytical tool that can increase the ability to separate and identify blood VOCs. The introduction of new analytical approaches and technological developments requires the critical assessment of instrumental parameters and their combination. In this study, GC×GC-TOFMS conditions were evaluated such as modulator type and mass spectrometry options. Flow modulation and thermal modulation were compared in order to determine their impact on sensitivity and resolution of the GC×GC analysis. Low resolution and high resolution (HR) TOFMS, in addition to hard and soft electron ionization (EI), were tested to achieve improved identification due to the increased presence of molecular ion in soft EI mode, and high mass resolving power afforded by the accurate mass measurement of HR instruments. Enhanced ionization procedures contributed to higher success in providing correct VOC identifications which will assist in developing forensic search methods for blood and victims of mass disasters or homicide. The results demonstrated that by taking advantage of a broad array of instrument technical capabilities, blood VOC analysis will be able to reach its full potential in the future and contribute to practical advancements in the forensic sciences.