E42 K9 Water Searches and Volatile Organic Compounds (VOCs): A Method to Aid in Determining the Location of Submerged Human Bodies

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The goal of this presentation is to demonstrate to the forensic science community specific VOCs from submerged human bodies that elicit an appropriate response by recovery canines (K9s).

This presentation will impact the forensic science community by showing how the identification of the VOCs released by submerged pieces of organs may be useful to better define VOCs produced by human material decomposition and as aids for training water search cadaver dogs to identify submerged human bodies.

Forensic personnel are frequently requested to locate submerged victims of homicides, drownings from boating accidents, or suicides. Search methods used to locate submerged bodies routinely include deploying underwater cameras or specialized dive teams, though properly trained cadaver dogs can also be effective at locating submerged human bodies or remains.

A recent increase in the use of trained water search canines for detecting submerged human bodies has created the need to have an exact knowledge and awareness of the volatile chemical signature of compounds that could indicate the presence of submerged human bodies. Although human scent is defined as the most abundant VOC, only a few VOCs, emanating from the submerged bodies, transit the water to stimulate canine olfactive alerts. Indeed, dogs don't smell submerged bodies through the water. VOCs from submerged bodies can enter the water, rise through it to the surface, and so enter the air to be detected by the canine olfactory system.

This study to detect the VOCs released from submerged human cadaveric bodies, which stimulate canine olfactive alerts, was performed using Gas Chromatography/Mass Spectrometry (GC/MS). Pieces of organs (skin, muscle, fat, brain, heart, lung, spleen, liver, and kidney) from four traffic-accident fatalities (two men and two women, excluding cases of intoxication) were used. The samples were stored in 24 separate glass jars (12 containing salt water and 12 containing fresh water). The glass jars were covered by a film with holes in it, above which were arranged several VOC-free cotton gauze pads, then the jars were closed by a cover. The water temperature at the surface was 0°C (4 salt water and 4 fresh water), 15°C (4 salt water and 4 fresh water), and 30°C (4 salt water and 4 fresh water). The gauze was used in part for the chemical analysis and in part for dog training procedures.

The first extraction was assessed on the gauze as time 0 of the experiment. The headspace extractions were repeated every 6 days for 120 days for each glass jar (20 extractions for each glass jar). The National Institute of Standards and Technology (NIST) mass spectral library and extracted ion chromatograms were used to identify the compounds.

More than 100 VOCs have been identified. Only VOCs that have been previously cited in the literature as originating from human specimens were used in the analysis of these samples as key markers of the presence of submerged bodies, from the water to the surface. The various molecules so identified, assessing their changes according to the temperature of the water, the decomposition process, and the water salinity were analyzed and selected. These results were included in a canine's training program in order to improve it to support the ability of using olfaction to locate submerged human bodies.

The results of this study indicate that the well-trained water search dog is an outstanding tool for detecting submerged human bodies, displaying excellent sensitivity (between 99.42% and 100%), having a Positive Predictive Value (PPV) ranging between 94.97% and 100%, and a Negative Predictive Value (NPV) ranging between 85.71% and 100%.

These recovery rates ranging between 99% and 100% indicate that properly trained water search dogs can make significant contributions in the location and recovery of submerged human bodies.

K9 Water Searches, Submerged Human Victims, Volatile Organic Compounds

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