A121 Volatile Organic Sulphur Compounds (VOSCs) and Accumulated Degree Days (ADD): Timing the Switch From Anaerobic to Aerobic Putrefaction

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After attending this presentation, attendees will better understand: (1) the link between VOSCs generated during decomposition and the timing of the switch between anaerobic and aerobic putrefaction; and, (2) how the processes involved in the timing of this switch may increase understanding in the hunt for the elusive Postmortem Interval (PMI).

This presentation will impact the forensic science community by providing data on the VOSCs generated by the putrefactive processes as they progress in individual tissues types. The findings contribute to forensic taphonomic research by improving understanding of the chemical and microbial processes that take place immediately after death and assisting in the goal of improved PMI estimation.

Previously, the research in this area was carried out on whole human cadavers and/or animals. The Volatile Organic Compounds (VOC) were collected by concentrating them from the air above cadavers, which produced large numbers of VOC in very complex patterns.[1,2] The goal of this research was to examine the putrefaction processes in individual tissue types and to analyze the VOC in a controlled laboratory environment in order to simplify the pattern and reduce the number VOC produced within a given time frame. By both reducing and controlling the variables investigated, a better interpretation of the VOC and VOSC production processes and their relationship to Accumulated Degree Days (ADD) is possible.

The research was conducted using tissues (liver, heart muscle, and skeletal muscle) harvested from a freshly killed pig (*Sus scrofa domestica*). Tissues were immediately placed on ice to slow the onset of autolysis. Porcine fecal material was used as a source of enteric bacteria to initiate the putrefactive process. Five grams of tissue were placed into a series of triplicate headspace vials, and 0.5ml of fecal materials was added to the tubes. Along with controls consisting of tissue blanks, air blanks, and fecal material blanks, the sealed vials were placed in a hot air incubator at 37°C for five days to initiate putrefaction. The temperature was monitored and recorded throughout the experiment, so that the amount of VOC produced could be related to the ADD at each sampling point. The VOC in the headspace above the tissue was extracted, separated, and identified by the Headspace/Gas Chromatograph/Mass Spectrograph (HS/GC/MS) at 24-hour intervals for eight days.

The most significant VOC produced during the eight days of data collection were the VOSCs Methyl Mercaptan (MM), Dimethyl Sulphide (DMS), Dimethyl Disulphide (DMDS), and Dimethyl Trisulphide (DMTS). Statistical analysis shows that there is a strong relationship between the production of VOSC and ADD in different tissue types. In liver tissue, the amount of DMDS and DMTS generated was very strongly related to ADD (p <0.005) above 280 ADD. In heart tissue, DMDS was very strongly related to ADD (p <0.005) above 280 ADD, whereas in skeletal muscle, only MM was very strongly related to ADD (p <0.005) above 310 ADD. As DMDS and DMTS are produced by the oxidation of MM and as MM is produced by an anaerobic process, the relationship of these compounds to one another can indicate the presence of anaerobic or aerobic conditions and the switching from one condition to another over time.

In conclusion, the order of decomposition evinced by the results of this study (liver > heart > skeletal muscle) is the same as that described by Gill-King.[3] The switching between anaerobic and aerobic conditions as indicated by the relationship between VOSC and ADD has not been demonstrated previously, and further research is required to establish the determining factors.

Reference(s):

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2. Statheropoulos M., Spiliopoulou C., Agapiou A. A study of volatile organic compounds evolved from the decaying human body. *Forensic Sci Int* 2005;153(2-3):147-155.
3. Gill-King H. Chemical and ultrastructural aspects of decomposition. In: Haglund W.D., Sorg M.H., editors. *Forensic taphonomy: the postmortem fate of human remains*. Boca Raton, FL: CRC Press, 1997:93-108.

Decomposition, Acumulated Degree Days, Volatile Organic Compounds

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