G29 The Persistence of an Elevated Concentration of Ninhydrin-Reactive Nitrogen in Grave Soil

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After attending this presentation, attendees will understand that the concentration of ninhydrin-reactive nitrogen (NRN) in grave soil increases during the first year of decomposition while grave soil pH decreases.

This presentation will impact the forensic community by serving as a fundamental investigation into the estimation of extended PMI.

As time progresses, however, NRN concentrations fluctuate less making it difficult to estimate postmortem interval (PMI) over an extended period of time. This presentation will impact the forensic community by serving as a fundamental investigation into the estimation of extended PMI. Accurate estimates of extended PMI are currently difficult to achieve.

Although several methods to estimate postmortem interval (PMI) have been developed, there is no one method that can be used in all scenarios. Most of these methods focus on estimating early PMI (<30 days). As a consequence, relatively few methods have been developed to estimate extended PMI (>30 days). Recent investigations have shown that the decomposition of a body can have a significant effect on the chemistry of associated soil (grave soil) that persists into the extended PMI. One effect is an increase in the concentration of materials (organic nitrogen and ammonium) that react with ninhydrin. This material is referred to here as ninhydrin-reactive nitrogen (NRN). Eventually, (NRN) concentrations will return to basal levels and it is believed that this can be used to estimate PMI. To determine how long NRN persists in soil, and develop a tool to estimate extended PMI, the NRN concentrations of grave soil associated with decomposing cadavers (after 0, 1 or 3 years) were measured.

The experimental site was located at the University of Nebraska Agricultural Research Development Center located approximately 48 km north of Lincoln, Nebraska, USA. The site is a pasture that is intermittently grazed by cattle and horses. The soil at the site is a deep silty clay loam of the Yutan series (Mollic Hapludalf). The climate is temperate midcontinental characterized by hot summers, cold winters, and moderately strong surface winds. Average annual precipitation is 695 mm. Approximately 75% of the precipitation occurs between April and September. Mean annual temperature is 9.8°C with mean minimum and maximum temperatures ranging from 0°C (January) to 31°C (July). The vegetation at site is dominated by non-native grass (smooth brougham) and forb (white clover) with some native vegetation, including daisy fleabane, yellowwood sorrel nut sedge, and pasture rose.

Swine (*Sus scrofa*) carcasses (~40 kg) plus a control (no cadaver) were used. Swine were killed with blunt force trauma to the cranium and placed on their right side on the soil surface facing west. Soil samples were collected (0-5 cm depth) from adjacent to the cadaver following 0 years, 1 year, and 3 years of decomposition and analyzed for NRN and pH. This experiment was replicated three times, which resulted in a total of six swine cadavers.

A significantly ($P < 0.01$) greater concentration of NRN was observed in grave soil after one year but not after three years. Also, a significantly ($P < 0.01$) lower pH was observed in grave soil after one year but not after three years. The current results demonstrate that the concentration of grave soil NRN and soil pH associated with a 40 kg cadaver can return to basal levels between one and three years postmortem. Thus, the maximum PMI that can be estimated using an increase in grave soil NRN or a decrease in grave soil pH is one year. Further research should be conducted to increase the accuracy of these approaches. In addition, other compounds and elements in grave soil should be investigated for their use in estimating PMI greater than one year.

Forensic Taphonomy, Extended Postmortem Interval, Decomposition

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