Förster Resonance Energy Transfer (FRET) analysis between fluorescently active components present in sweat-fat substances and postmortem secretions as a potential tool for estimating the time of death

Amino acids, as fundamental components of proteins, play a pivotal role in various scientific disciplines, including medicine, biotechnology, and forensics. In medicine, they are essential for the synthesis of peptides and the diagnosis of metabolic disorders. In biotechnology, they are utilized for enzyme production and protein engineering. In forensics, amino acids are primarily employed in the detection and identification of biological material at crime scenes.

The objective of our research project is to determine the potential of amino acids and other compounds present in sweat-fat and post-mortem secretions as biomarkers to accurately determine the time of death. The estimation of the time of death is a crucial aspect in forensic investigations that requires continuous improvement. Despite the significant progress that has been made in this field and the development of many methods and techniques (including traditional, modern, and auxiliary), the estimation of the time of death still faces significant challenges. These challenges are primarily related to the multitude of external factors that interfere with the regularity of post-mortem transitions.

Nevertheless, the precision of estimating the time of death still falls far short of the standard of accuracy required in forensic medicine. Consequently, further research, both theoretical and experimental, is necessary. The objective is to identify potential biomarkers and develop new, non- invasive methods for accurately estimating time of death, which will reduce errors and provide new interpretive possibilities during initial environmental analyses. Furthermore, these methods may provide potential facilities for ultra-rapid identification of many diseases.

To date, studies have indicated that tryptophan, an amino acid present in sweat and postmortem secretions, may be a promising marker for determining the time of death. **We have demonstrated the spectroscopic stability of tryptophan in environments of different pH, which is important due to the variability of body decomposition processes.** Furthermore, we have identified other compounds whose proximity to tryptophan can enhance the analytical outcomes.

The current methods of estimating the time of death often necessitate compromising the physical integrity of the remains and the use of toxic chemicals to enhance the detection of low concentrations of biomarkers. **The objective of this project is to propose a non-invasive approach that employs spectroscopic analysis of free tryptophan, tyrosine, NADH and FAD, with the potential for Förster Resonance Energy Transfer (FRET) between these components**.

Furthermore, we hypothesize that the stabilization of selected biomarkers in polymer matrices will enhance their analytical capabilities. **The incorporation of these compounds into hydrogel polymeric ribbons will create suitable conditions for Förster Resonance Energy Transfer to occur between the components of sweat and fat substances and postmortem secretions.** The stabilization of biomarkers offers new insights into the procedure for estimating the time of death.

In the context of recent events such as armed conflicts and disasters, there is an urgent need for effective, rapid methods to estimate the time of death at the scene. The objective of our research is to develop a procedure that employs molecular spectroscopy to estimate time of death. **This project has the potential to provide a novel approach with rapid diagnostic tests based on biomarkers present in sweat-fatty substance and postmortem secretions.** These tests could speed up forensic procedures and influence the development of diagnostic tests for diseases, including cancer.