Raman spectra facilitate screening of ancient teeth indicating their relative content in endogenous genetic material

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Human and animal skeletal remains from archaeological contexts, constitute a unique source of endogenous bioorganic matter both proteinaceous and genetic. In particular, tooth cementum (the hard outer tissue of the root) has been found to offer significant preservation to both protein and DNA, thus facilitating researchers in palaeoproteomics and palaeogenetics to extract important information from such “archives”. However, in order to minimize costs and uncessary destruction of bioarchaeological material associated with proteomics or ancient DNA analyses, as well as enhance the throughput of such studies, quick screening methods are sought for. These would offer accurate assessment of the preservation of bioarchaeological matter in teeth and bones, thereby preventing valuable samples from destruction. In this context, Raman spectroscopy has been investigated with regard to its potential to assess the protein content of ancient teeth, which in turn can act as an indirect indicator for the presence of endogenous DNA. Raman spectra collected from a collection of ancient teeth, reveal features arising from the mineral/inorganic matrix, mainly hydroxyapatite as well as from organic matter, typically collagen. The relative organic content of tooth samples, expressed as a spectral ratio of the amide-to-phosphate bands (Am/P) exhibits a weak to medium correlation with the amount of endogenous DNA (independently determined using ancient DNA analysis). Combining this indicator with a second one, C/P, which represents the amount of carbonate ions in the phosphate matrix enables a satisfactory/reliable screening of samples with poor content of endogenous DNA versus those with high DNA content. Studies are extended so as to include a broader collection of samples in order to produce a more robust statistical assessment of the proposed method while, in parallel, chemometrics is applied to facilitate screening.

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10 line bio (for website)

Demetrios Anglos is Professor at the Department of Chemistry, University of Crete and Associated Researcher at IESL-FORTH, where he leads the Applied Spectroscopy Laboratory. The activities of his research group focus on a) the study of photophysics in molecules and novel nanomaterials with potential sensing applications, and b) the applications of laser spectroscopic techniques (LIF, LIBS, Raman spectroscopy) in the analysis of materials/objects coupled to the development of mobile, field-deployable instrumentation with diagnostic potential in heritage science. Over the past few years he has concentrated his attention on European and National Initiatives which aim at developing Research Infrastructures relevant to Cultural Heritage Science, E-RIHS (European Research Infrastructures for Heritage Science) and E-RIHS.gr.

10 line abstract (for website)

Raman spectroscopy has been investigated as regards its potential to assess the protein content of ancient teeth, a strong indicator of the teeth preservation, and through this it has been found to provide indirect, but sound indication for the presence of high levels of endogenous DNA. The relative organic content of tooth samples, expressed as a spectral ratio of the amide-to-phosphate bands (Am/P) exhibits a medium-level correlation with the amount of endogenous DNA determined independently. The combined use of (Am/P) with an additional indicator, C/P, which reflects the amount of carbonate ions in the phosphate matrix enables a satisfactory screening of samples poor in endogenous DNA versus rich ones.