Discrimination of Burned Human Remains through Vibrational Spectroscopy

Calil Makhoul [1] , Eugenia Cunha [1], Luis Batista de Carvalho [4], David Gonçalves [1-3]

[1] CFE- Centre for Functional Ecology ,Laboratory of Forensic Anthropology, Department of Life Sciences, University of Coimbra. Calçada Martim Freitas, 3000-456, Coimbra, Portugal.
[2] Research Centre for Anthropology and Health (CIAS), Department of Life Sciences, University of Coimbra. Calçada Martim Freitas, 3000-456, Coimbra, Portugal.
[3] Archaeosciences Laboratory, Directorate General for Cultural Heritage and LARC/CIBIO/InBIO, Rua da Bica do Marquês 2, 1300-087 Lisboa, Portugal
[4] Research Unit "Molecular Physical Chemistry", Faculty of Science and Technology, University of Coimbra, 3004-535 Coimbra, Portugal.

E-mail: kmakhoul@hotmail.com

Introduction

In forensic anthropology, physico-chemical methods have shown a lot of potential, especially in the examination of forensic cases involving fire. However, the applicability of this approach has not been tested in burned human remains. Therefore, the hypothesis being tested is that burned remains from each individual present unique bone structure/chemical composition depending on their own diet, physiology and metabolism. The primordial results of the experimentally burned clavicle shows that the microRaman spectroscopy adds valuable information in the individualization approach in case of burned commingled and/or scattered human remains.

Material and Methodologies

- Samples of the proximal and distal regions of the 10 burned clavicles (right antimere) belonging to the 21st Century Identified Skeletal Collection of the University of Coimbra (UC) (1).
- Experimental burning process at temperatures from 450 ºC to 1050ºC exposed to a different duration (45 min. to 240 min.) were performed (Fig. 1).
- Spectral composition were analyzed through microRaman Spectroscopy at the Molecular Physical-Chemical R&D Unit of UC.
- Statistical Analysis and Multidimensional Scaling.

Results

Based on chemometric tools, the distal and proximal sampling on the same bone had no significant variation (Fig. 2) and samples of the skeletons belonging to the same individual will have proportional similarity allowing the assemblage of bones from the same individual and, in parallel, producing a statistically significant discrimination between different individuals (Fig. 3,4). However, in theses first results, we obtained heterogeneity of spectra of a clavicle in a same location (distal and proximal), this might bring us new hypothesis of what may cause this heterogeneity demanding even further research.

Conclusion

The physico-chemical approach shows to be a promising methodology. Based on the first results, it is capable to individualize burned bones in commingled or scattered events. Also, further research must be done to explore the cause of heterogeneity spectra obtained.

Acknowledges

David Gonçalves FCT Grant SFRH/BPD/84268/2012

Fig. 1: Comparison between an unburned clavicle and an experimentally burned clavicle (CEI/XXI-116) at 900 ºC for 120 min.

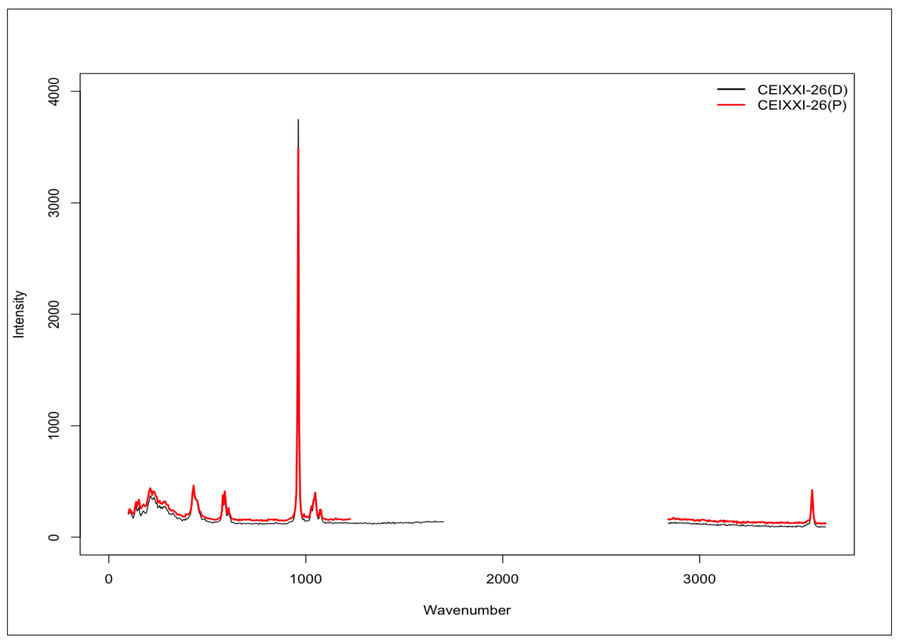

Fig. 2: Two clavicle samples (proximal and distal region) of same individual (red and black) show similar spectra.

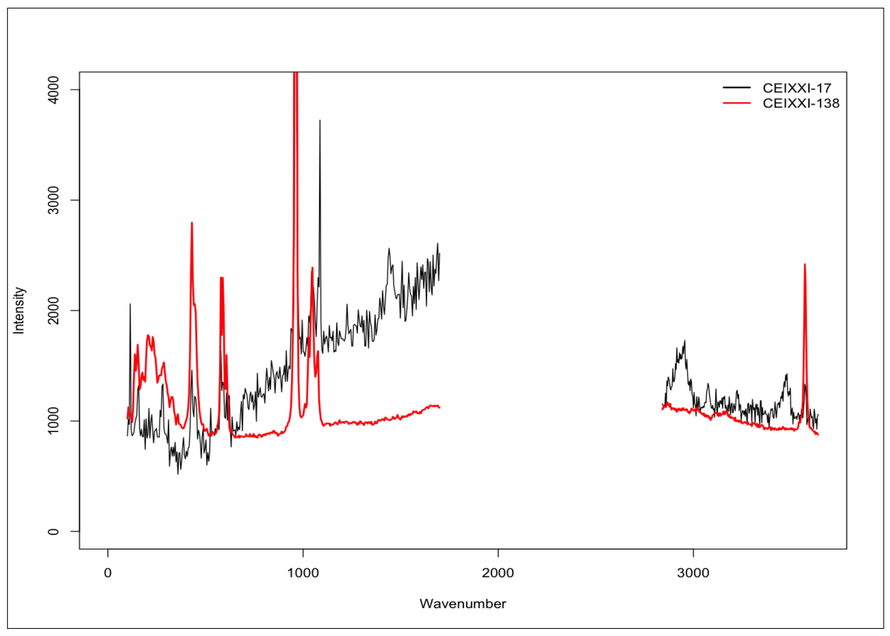

Fig. 3: Two burned-clavicle samples of different individuals (black and red) show dissimilar spectra indicating a possible individualization approach, although there is differences in the burned temperature (900 ºC and 1000 ºC).

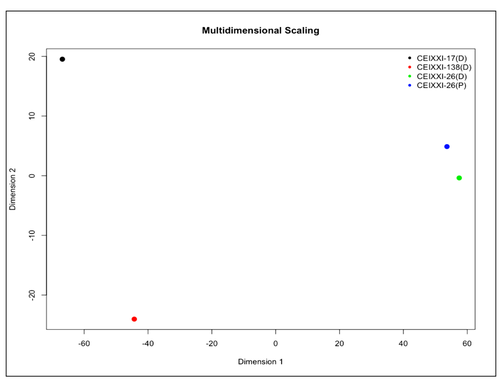

Fig. 4: Multidimensional Scaling depicts the individualization of four samples. Blue and green spots are the samples corresponding to the sample clavicle from different regions (proximal and distal regions), whereas red and black spots are samples collected from different individual.

References

1- Ferreira, M.T., Vicente, R., Navega, D., Gonçalves, D., Curate, F., Cunha, E., 2014. A new forensic collection housed at the University of Coimbra, Portugal: The 21st century identified skeletal collection. *Forensic Science International, 245*: 202-e1

LARC Laboratório de Arqueociências · CIAS PEst-OE/SADG/UI0283/2013 · U C · Universidade de Coimbra – Alta e Sofia Inscrita na Lista do Património Mundial em 2013
FCT Fundação para a Ciência e a Tecnologia MINISTÉRIO DA CIÊNCIA, TECNOLOGIA E ENSINO SUPERIOR Portugal
POPH · QREN Quadro de Referência Estratégico Nacional · União Europeia Fundo Social Europeu
Centre for Functional Ecology
HOT ResearcH PrOject of the CEI/XXI Burned SkeleTons
Visit us at: www.hotresearch.wix.com/main