Séminaire de recherche IRAMAT-CRP2A / CBMN

Mardi 19 décembre à 14h00 Amphi de la Maison de l'Archéologie

Esplanade des Antilles – Université Bordeaux Montaigne

Art and Cultural Heritage natural polymers by bottom up and top down approaches

Professeur **Caroline Tokarski**
Miniaturisation pour l'Analyse, la Synthèse & la Protéomique (MSAP), USR CNRS 3290, Université de Lille 1 Sciences et Technologies, 59655 Villeneuve d'Ascq, France.

Abstract

The study of organic matter in Cultural Heritage samples is a real analytical challenge. Organic compounds are included in a complex matrix. They are submitted to environmental stress, denaturation and ageing for years. Finally, very low sample amounts are available for analysis. Considering artworks, characterization of organic compounds is an invaluable source of information for knowledge, understanding of a manufacturing process or comprehension of an artist's technique. This information is also of main importance to propose adapted conservation conditions and best preservation/restoration treatments. In the case of archaeological and paleontological samples, information related to proteins may inform on species phylogeny, evolutionary links but also human habits.

Until recently, the organic compounds from Cultural Heritage samples were analyzed via their constitutive moieties (e.g. amino acids, fatty acids, monosaccharides) inducing a loss of information. In the early 2000s, we have successfully adapted proteomic (bottom up approach) and lipidomic methodologies to the study of few micrograms of historic art paintings or archaeological samples allowing for the first time the accurate structural identification as well as the identification of the biological species. These methodologies are currently used in the most famous international museums (e.g. Metropolitan Museum of Art, New York; Harvard Art Museum in Cambridge).

This conference will address our current challenges for analysis of Cultural Heritage samples:

(i) Because bottom up proteomics sometimes causes a loss of structural information or suffers from modifications induced by sample handling, we propose novel developments based on native protein analysis and top down proteomics. Application to the study of historic artworks (art paintings, photographs) will show how top down proteomics inform accurately on the degradation mechanisms of the organic media (e.g. protein breakdown) and protein chemical modifications such as oxidation, deamidation etc. (i.e. impact of restoration procedures and conservation conditions at molecular level). On another aspect, applied to the study of archaeological bones, relationship between protein chemical modifications, environment and ageing will be introduced (e.g. study of the 10-years frontier between forensics sciences and archaeology).

(ii) Applied to the study of historic watercolors and drawings exposed in the Metropolitan Museum of Art (New York), our metabolomic-like strategy using an enzyme cocktail will be presented through the identification of gums by structural elucidation and despite limitations such as partially unknown polymer structures and very low sample amounts.

(iii) The third example will develop potentialities of very high resolution mass spectrometry in combination with soft depolymerization experiments. This method unravel the 3D networks formed by the insoluble lipid-based film in oil-paintings. These first results provide new information related to the network structure formed between the unsaturated fatty acids in art oil painting via the detection of various multimers linked by C-C, C-O-C or C-O-O-C bonds. In particular, evidence of addition of β scission radical intermediate in the 3D framework are shown. We also observed that the hydrolysis of the bonds between the fatty acids and the glycerol results in fatty acid release known to be responsible of paint degradation by soap formation with pigment cations.

Methodological developments applied to Cultural Heritage: focus on identification of protein structure

Methodological develoments applied to the study of lipids from Cultural Heritage

Short CV

Caroline Tokarski is Professor at Lille University. She is head of the MSAP laboratory (USR CNRS 3290) and member of the "Institut Universitaire de France". She is also co-responsible of the Proteomic platform of Lille (IBISA label) and TGE FT-ICR platform of Lille. Her research activities are focused on methodological developments for analysis of proteins, lipids and carbohydrates from native or transformed biological samples using high resolution mass spectrometry. In particular, she proposed to adapt proteomics and lipidomics to cultural heritage samples to identify accurately proteins/lipids, their modifications and their biological origins. Currently these techniques are used routinely in the analytical laboratories of the most famous museums in the world (e.g. Metropolitan Museum of Art, New York; Harvard Art Museum, Cambridge). She was awarded by the Division of Analytical Chemistry of the French Chemistry Society in 2011. She is currently coordinator of Horizon 2020 JPI-JHEP 'LeadART' (2014-2018; 11 european partners) and coordinator of NORD_ART networks (NORD_ART links research, museums and archaeology in the Hauts de France region). Beyond her research activities, she is the study Director of the Bioanalytics' specialty of the Chemistry and Health Sciences Master of the University of Lille (since its creation in 2010).