Ph D proposition – MESR funding / start october 2018

Structure/properties relationships of constitutive biopolymers of the oral mucosa: definition of molecular and organizational markers of ageing

Management

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Profile : biomaterial science, Physico-chemistry

Candidature before april 20th

Key words: physical structure, thermal analysis, biomaterials, spectroscopies

Presentation

Health sector is one of the 5 areas of research and development of the Chimie Balard Cirimat Carnot Institute. With an ageing population, the thematics Ageing and improvement of the quality of life is a primary challenge of the society, both at the national and european level. Edentulism is prevalent in ederly patients and the current treatment is the use of removable protheses based on edentulous jaw regions. Nevertheless, the close and extended contact of prosthetic intrados with fibromucosa and the transmission of occlusal strengths trough the prosthesis leads to a weakening of supporting tissues in the medium to long term. This embrittlement may be accompanied by pain, compromising the proper integration of prostheses. In geriatics, the peculiar weakness of bearing surfaces, connected to physio-pathological conditions as well as the decrease of adaptability and resistance further complicate the biomechanical integration of this kind of prosthesis.

It has been shown that chronical ageing induces a decrease of resiliency and hydration of oral mucosa, associated with a decrease of epithelium thickness; nevertheless few studies have been performed at the molecular and supramolecular level to characterize this mucosa, and even fewer on the structural and mechanical evolution with ageing. FTIR [1] and Raman [2] analyses on animal mucosa are promising techniques of characterization on such tissues, as well as dielectric analysis used to discriminate between safe and pathological mucosa [3].

Techniques of material characterization (Fourier transform Infrared spectroscopy, Differential scanning calorimetry (DSC), Thermostimlulated currents (TSC), Dynamic dielectric spectroscopy (DDS) and Dynamic mechanical analysis (DMA)) have been shown to be well suited to study different biological tissues and proteins in the PHYPOL team of CIRIMAT [4,5]. The objective of this work is to adapt these techniques to scan the physical structure and dynamics of mucosa in order to extract vibrational, thermal, mechanical and dielectric markers and to follow their evolution with ageing.

The complementarity of the thesis directors (materials physicist and hospital practioner) will be considered an advantage to manage this plurydisciplinary subject, based on **biophysical characterization**, where the clinical issues are promising.

Retro planning:
October 2018-january 2019: earliest stage
 Research and tests validations on porcine mucosa
 State of art /Design of clinical study
February 2019-February 2021:
 Biophysical analyses (FTIR/Raman/TSC/DSC/DMA) of human mucosa
 Multivariate analysis of data
 Extraction of ageing markers
 Communications (Congresses/publications)
February 2021-September 2021: Thesis report/communications

[1]	J.C. Schwarz, E. Pagitsch, C. Valenta, Comparison of ATR–FTIR spectra of porcine vaginal and buccal mucosa with ear skin and penetration analysis of drug and vehicle components into pig ear, Eur. J. Pharm. Sci. 50 (2013) 595–600.
[2]	A. Sahu, A. Deshmukh, A.D. Ghanate, S.P. Singh, P. Chaturvedi, C.M. Krishna, Raman Spectroscopy of Oral Buccal Mucosa: A Study on Age-Related Physiological Changes and Tobacco-Related Pathological Changes, Technol. Cancer Res. Treat. 11 (2012) 529–541.
[3]	C. Murdoch, B.H. Brown, V. Hearnden, P.M. Speight, K. D 'apice, A.M. Hegarty, J.A. Tidy, J. Healey, P.E. Highfield, M.H. Thornhill, Use of electrical impedance spectroscopy to detect malignant and potentially malignant oral lesions, Int. J. Nanomedicine. 9 (2014) 4521–4532.
[4]	Lacoste-Ferré, P. Demont, J. Dandurand, E. Dantras, D. Duran, C. Lacabanne C., Dynamic mechanical properties of oral mucosa: comparison with polymeric soft denture liners, Journal of the Biomechanical Behavior of Biomedical Materials, 2011, 4(3) 269-274.
[5]	R. Tang, V. Samouillan, J. Dandurand, C. Lacabanne, M.-H. Lacoste-Ferre, P. Bogdanowicz, P. Bianchi, A. Villaret, F. Nadal-Wollbold, Identification of ageing biomarkers in human dermis biopsies by thermal analysis (DSC) combined with Fourier transform infrared spectroscopy (FTIR/ATR), Ski. Res. Technol. 23 (2017).