

Spectral markers and morphological features of diabetic foot ulcer tissues

T.D. Isokov¹, L.V. Yanitskaya², S.V. Verevka³, O.P. Gnatyuk¹, T.V. Voitsitskyi¹, G.I. Dovbeshko¹

(1) Department of Physics of Biological Systems, Institute of Physics, Natl. Acad. of Sci. of Ukraine, Kyiv, Ukraine.

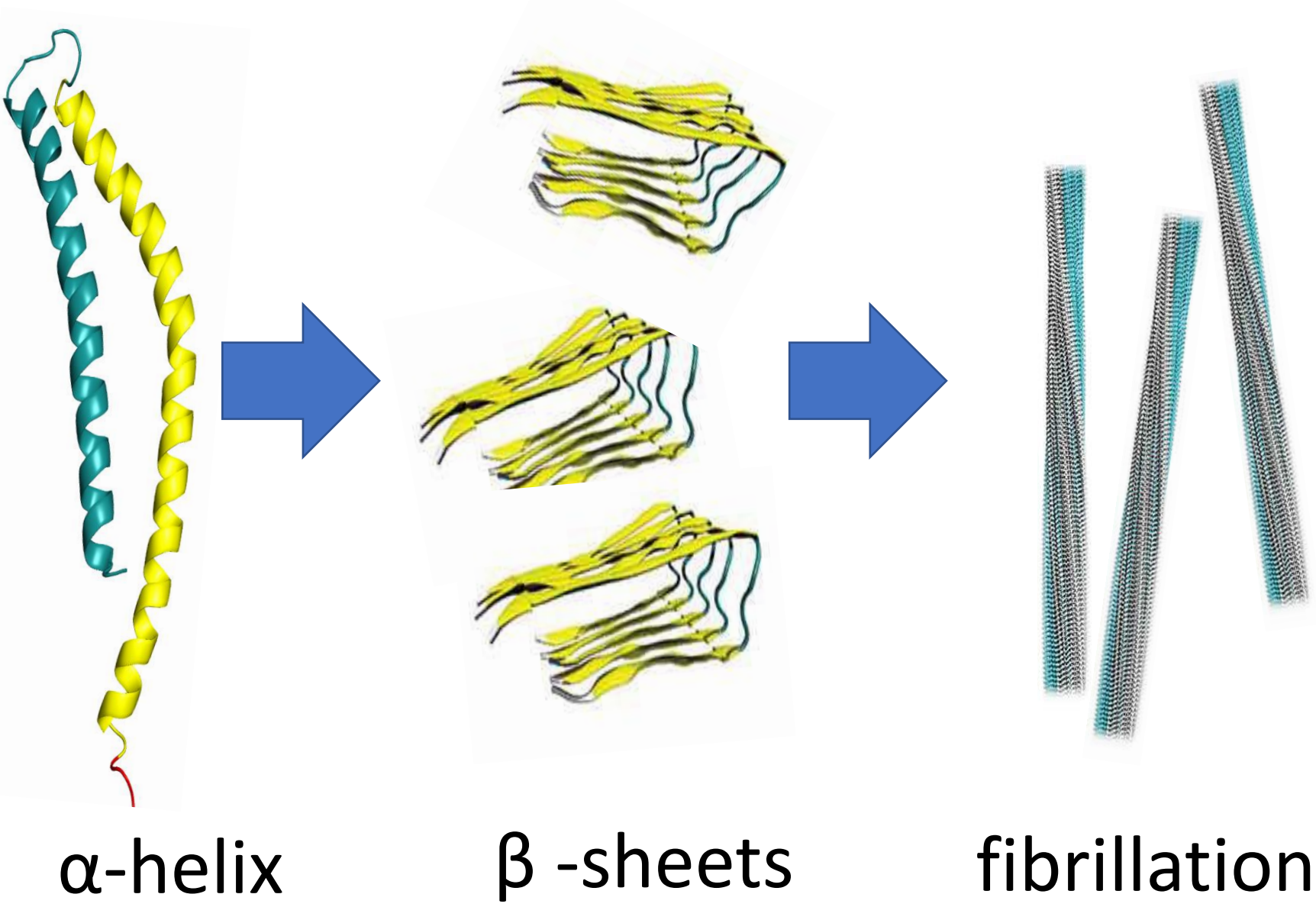
(2) Bogomolets National Medical University, Kyiv, Ukraine

(3) SI "O.S. Kolomiychenko Institute of Otolaryngology, NAMSU", Kyiv, Ukraine

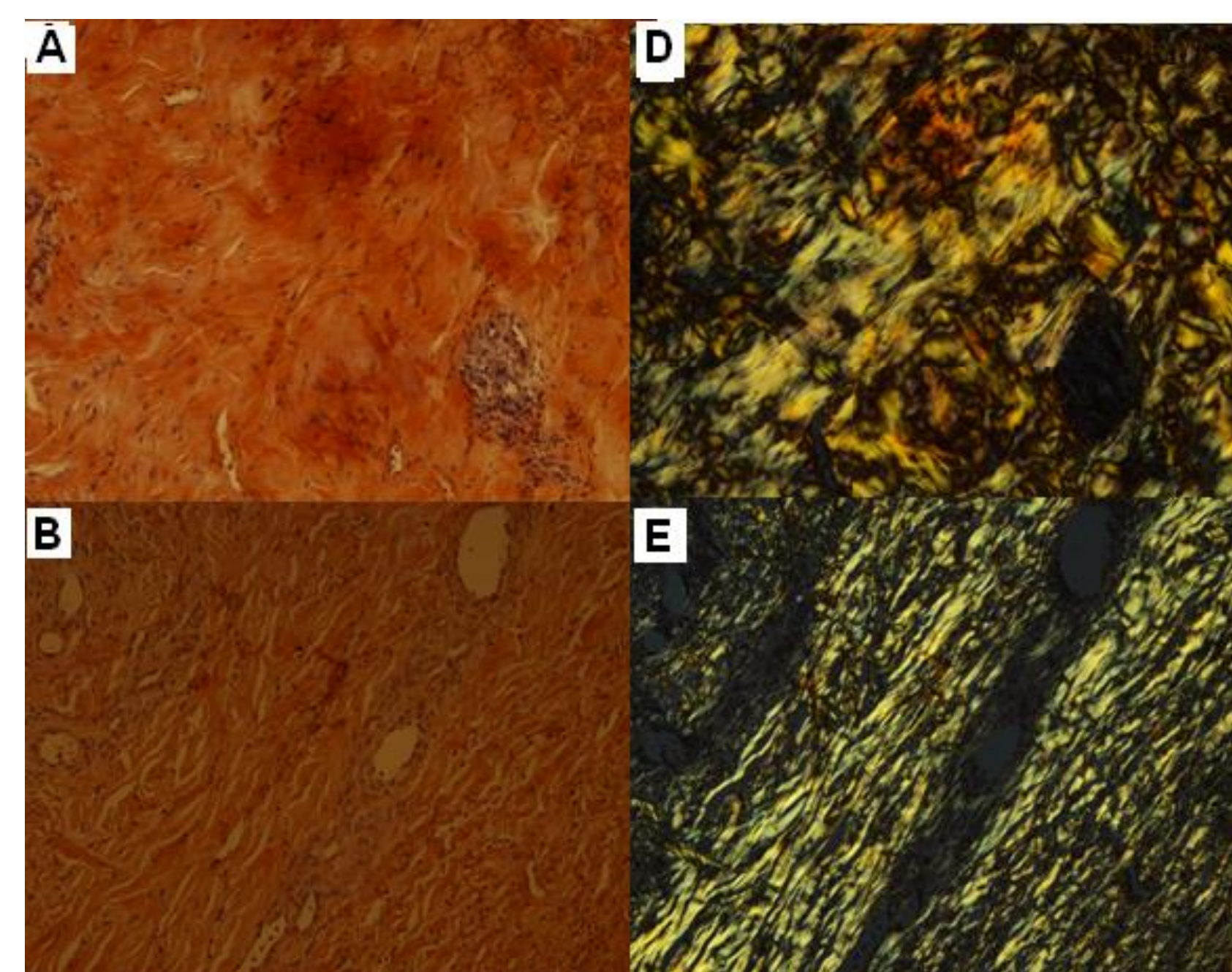
Introduction:

The formation of β -structured protein aggregates promotes their non-enzymatic glycosylation, which in turn promotes aggregation. Thus, there is a positive connection between the individual links of the pathological process. Breaking this link is a prerequisite for effective treatment.

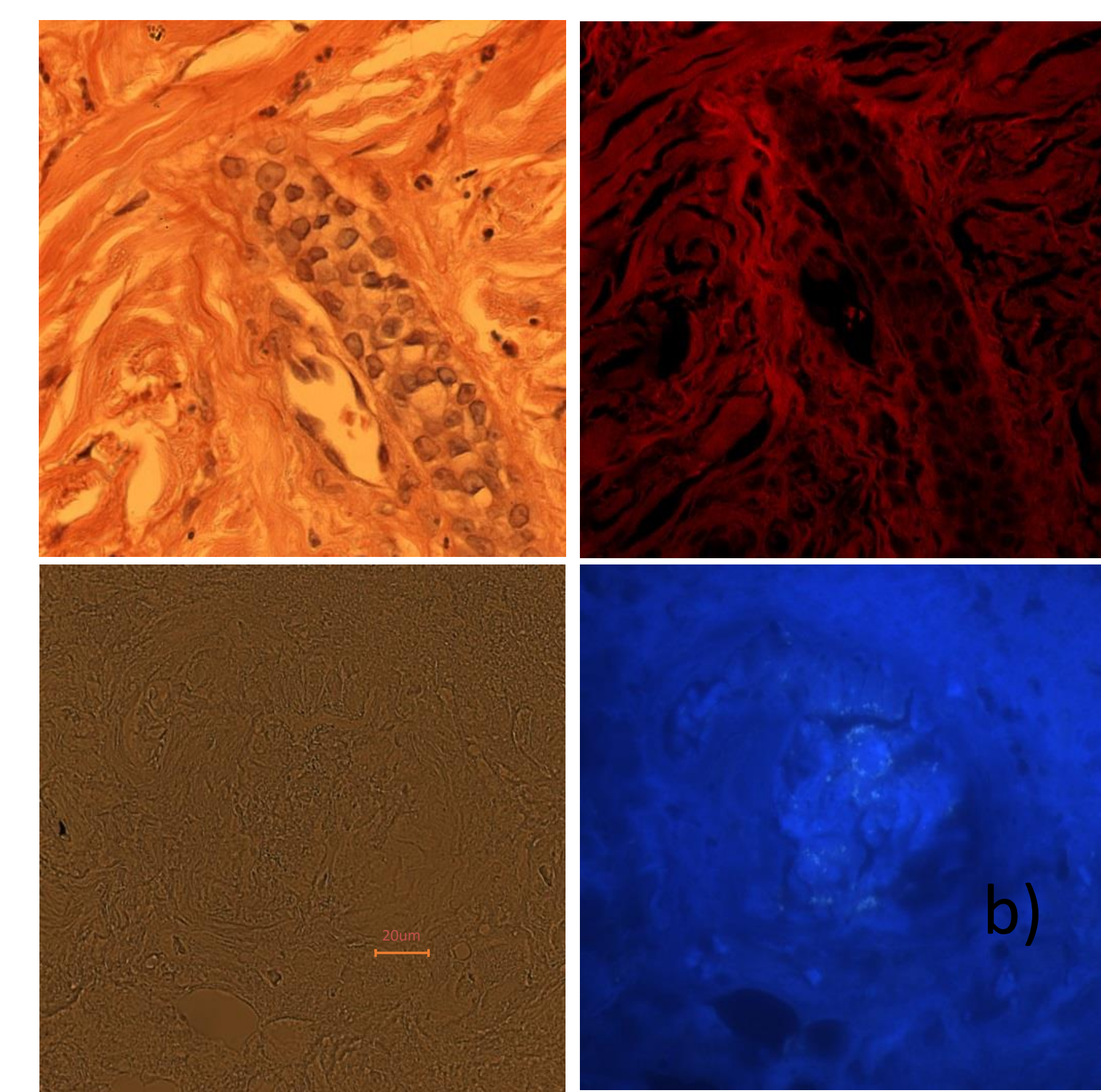
β -structures is formation in diabetic food?



Polarization and Fluorescence microscopy:



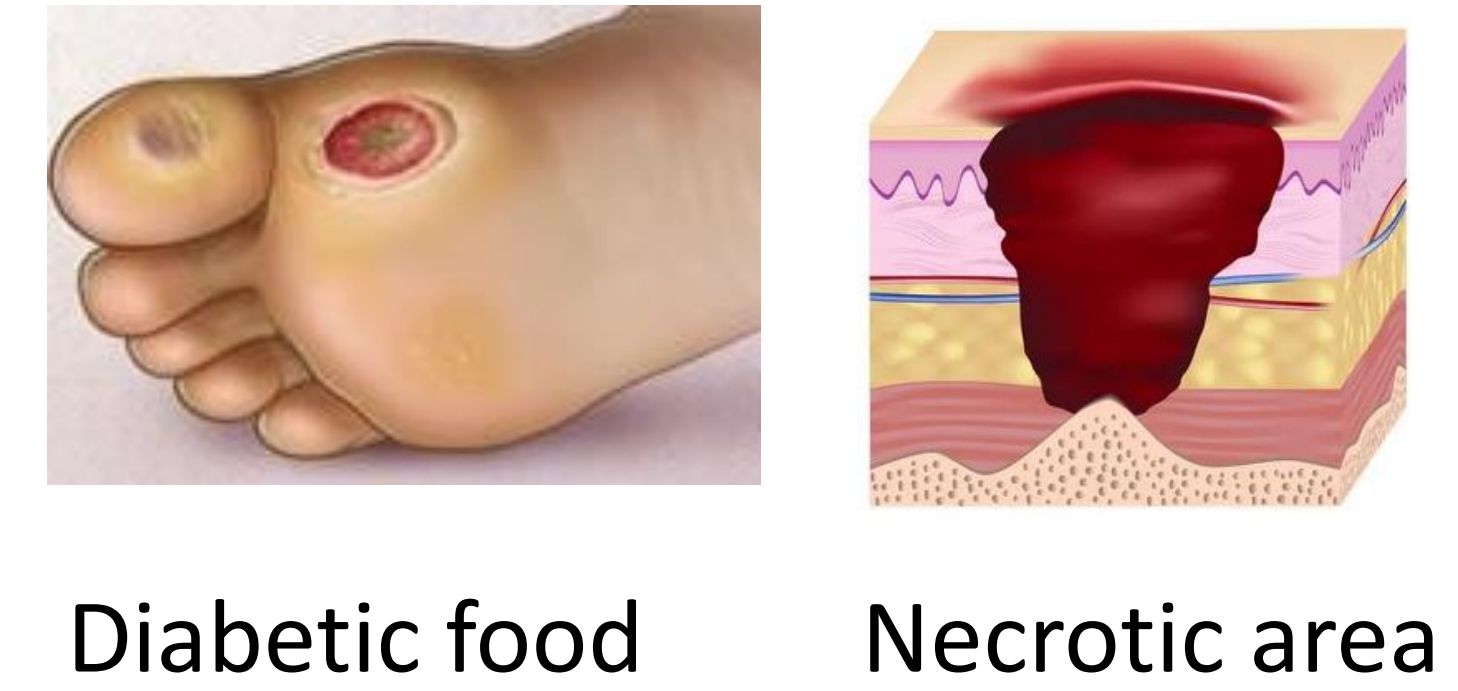
Polarizing image of diabetic foot tissue in x200 magnification
Preparation sample by Congo Red dye



Fluorescent image of diabetic foot tissue
Excitation on 543 nm
Tioflavin Excitation on 405 nm
The diabetic foot tissue prepared by fluorescent dye

Study goal:

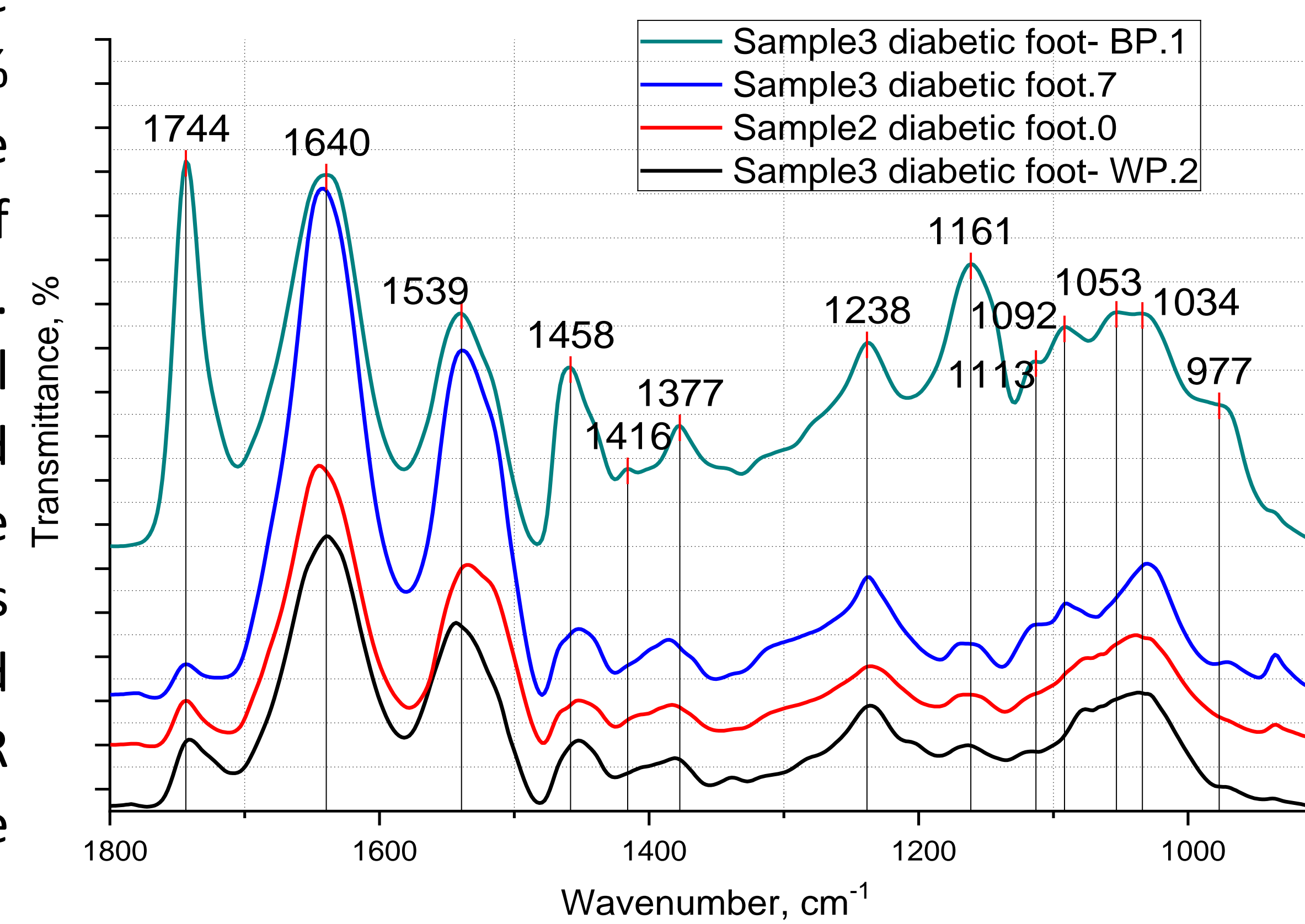
The aim of the study was to experimentally test the hypothesis of the formation and accumulation of β -structured protein aggregates in diabetic foot tissues.



Diabetic food

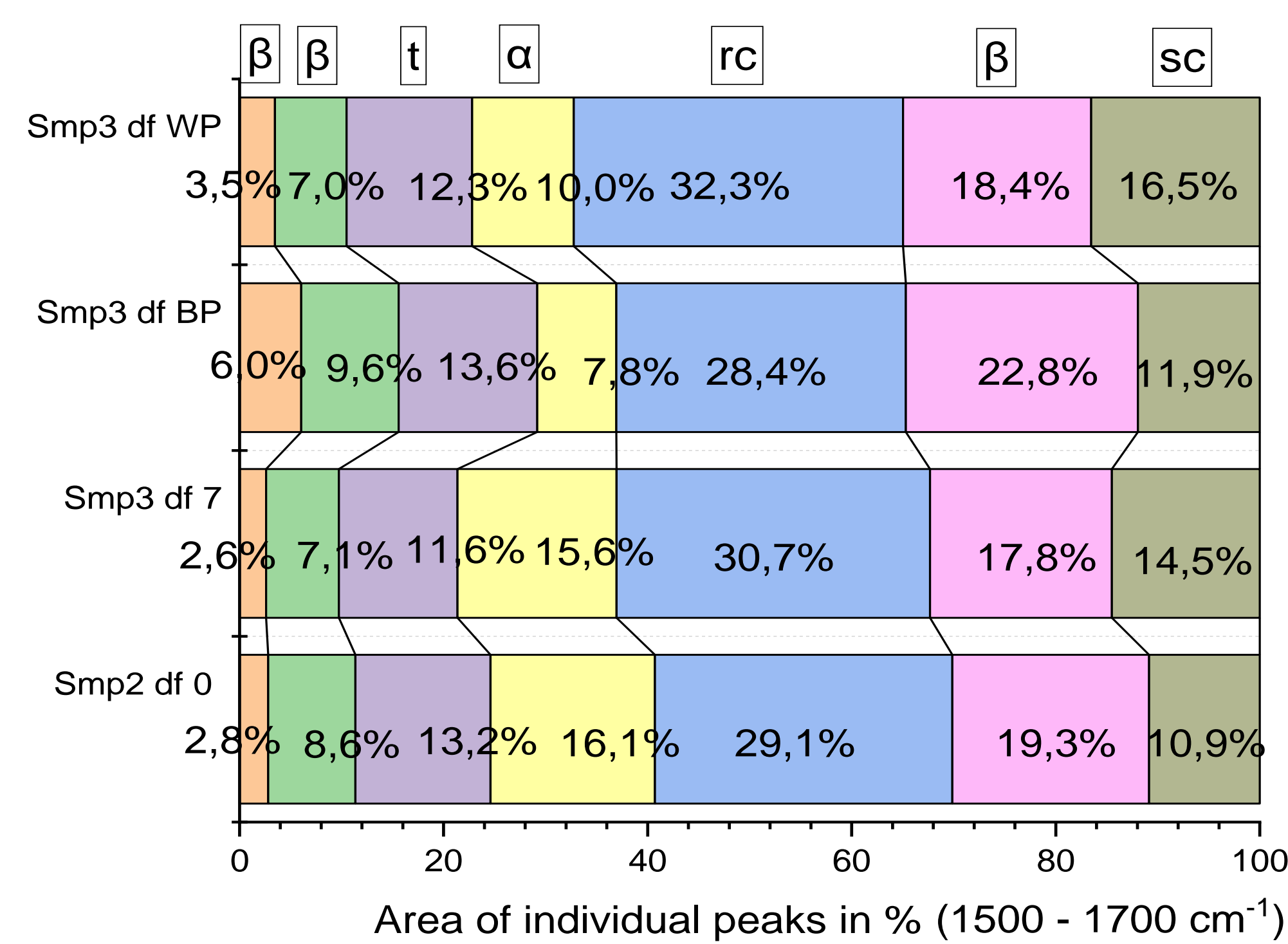
Necrotic area

FTIR spectra:

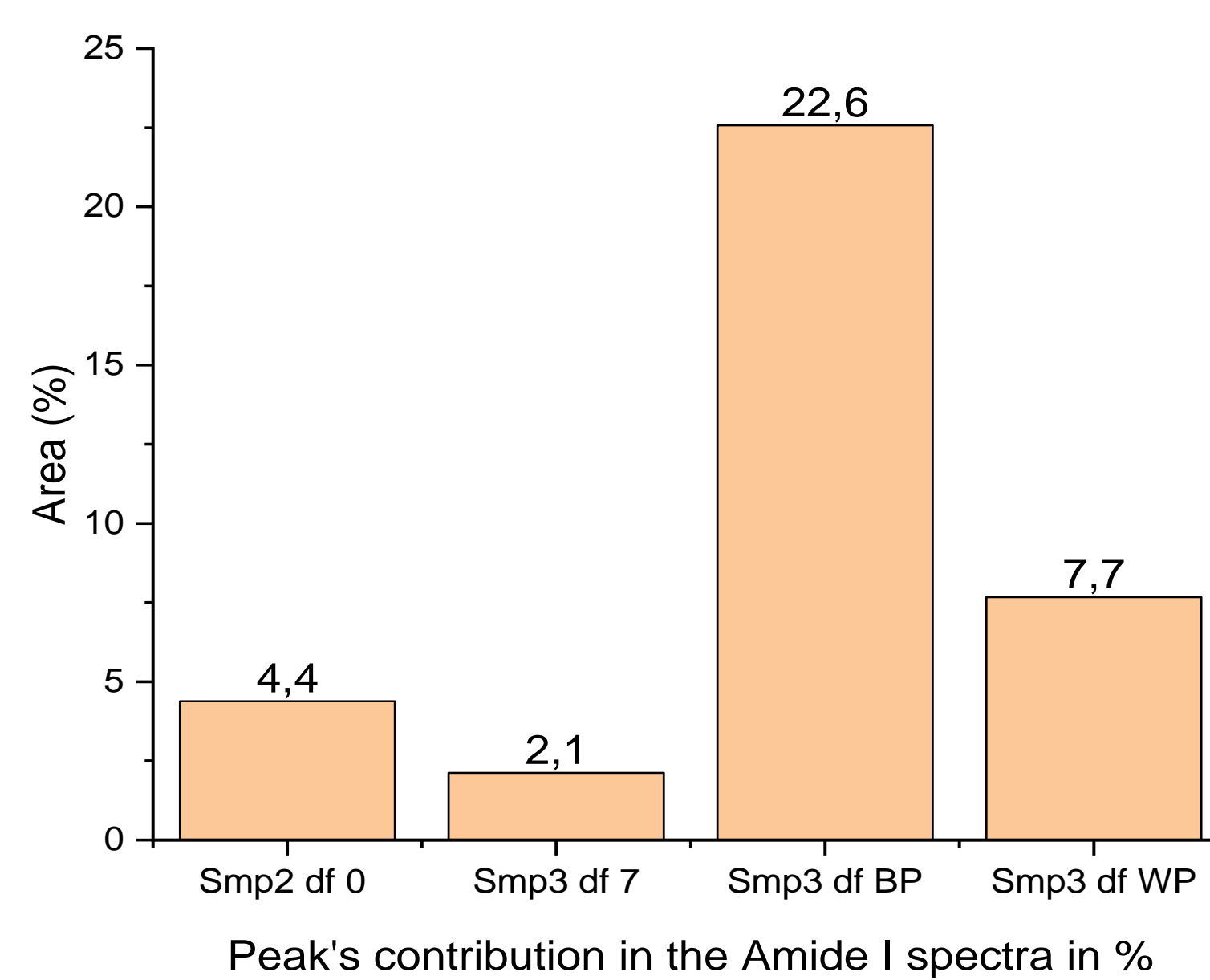


The study investigated samples of surgical material of pathological tissues of the diabetic foot with fixation in a 10% formaldehyde solution. The samples were taken in accordance with the provisions of bioethics with the consent of the patients. The structure of the studied histological samples was assessed with Congo red staining by Puchtler-Mayer. To register the infrared absorption spectra, the tissues were washed from formaldehyde and dried on the working surface of the ATR attachment in the cuvette chamber of the Tensor 27 FTIR spectrometer.

Area of individual peaks:

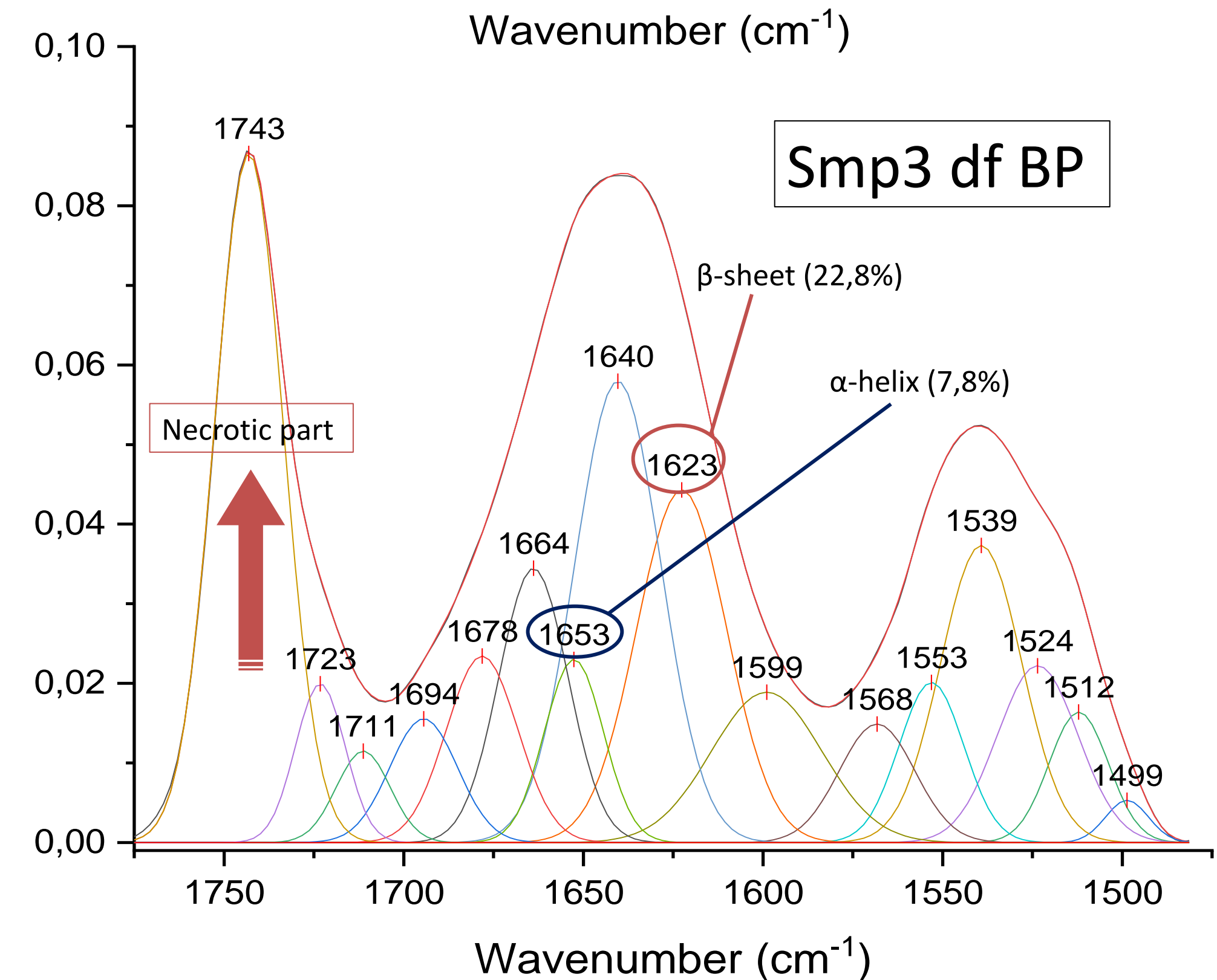
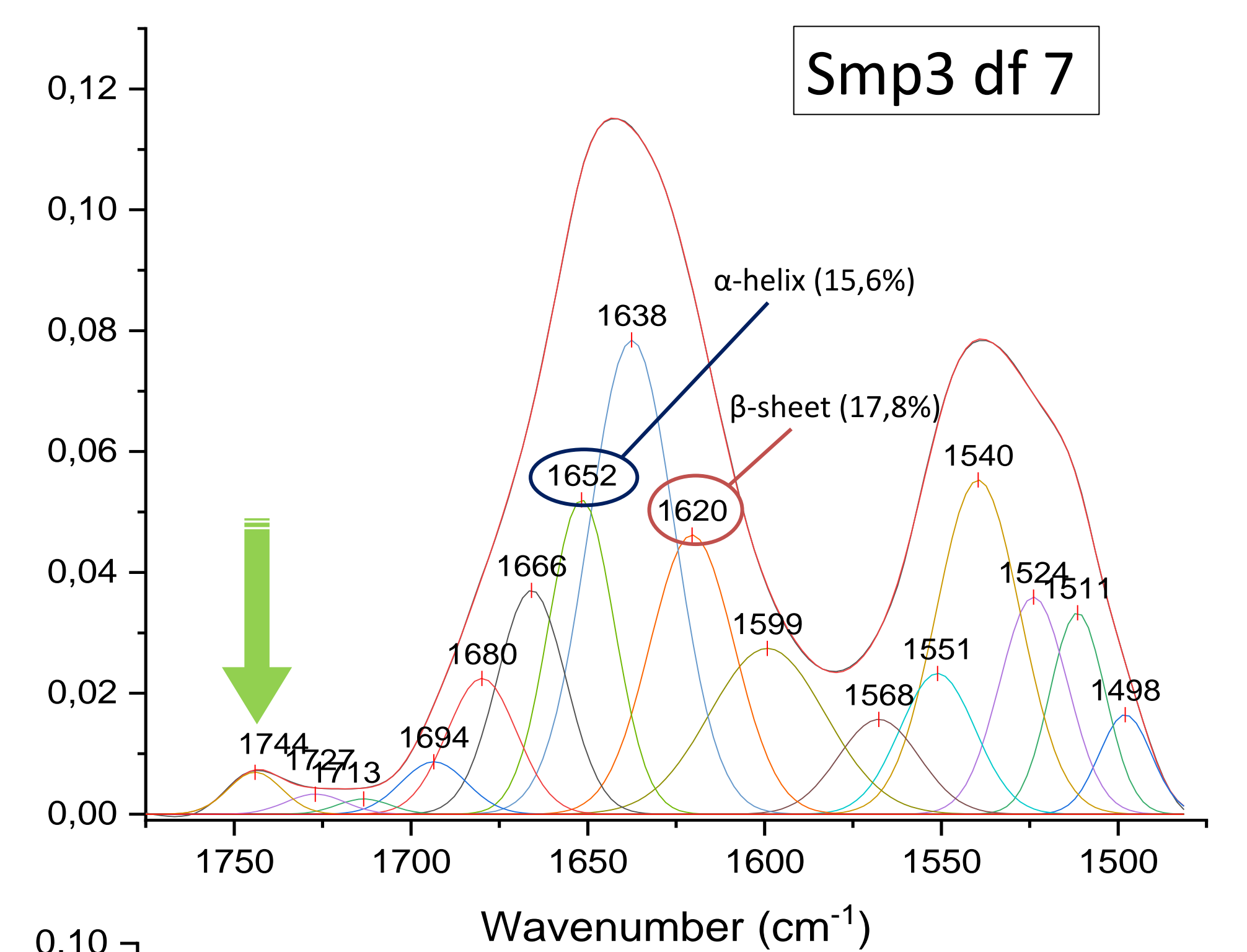


Each band is labeled as β -sheet (β), α -helix (α), random coil (rc), turn (t), or side chain (sc).



The Peak on 1743 cm^{-1} demonstrate significant contribute for Smp3 df BP.

Peaks deconvolution spectra of the Amide I:



Conclusions:

The results of the optical image analysis indicate the presence of β -structured protein aggregates, which was confirmed by IR spectroscopy. In addition, unique IR markers of necrotic tissues in the absorption region of stretching vibrations of C=O and C-O molecular groups were registered, and a 2.5-fold increase in the intensity of the CH stretching bands was observed compared to OH.

The obtained data raises the question of the necessary methodological approaches to prevent sores progression and require further research to develop effective therapeutic strategies.