Spectroscopic and structural investigations on albumin reversibility and conformational changes under stress conditions: implications in nanomedicine

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Albumin is the most abundant protein in body fluids and is involved in many human responses, such as anti-inflammatory processes [1]: the aim of our research is to study the spectroscopic and structural changes in albumin under different stress conditions and their reversibility. By studying the behaviour of albumin under biologically modified conditions, we may be able to better understand and manipulate the biochemical processes that affect it, with the aim of using it for therapeutic purposes, exploiting all its advantages.

In our studies, we investigated changes in albumin subjected to oxidative damage and subsequently verified a hypothetical reversibility. UV-visible absorbance analyses and SEC-SAXS measurements demonstrated an effective chemical and conformational change of the protein, as well as a partial return to its native state when treated with a reducing agent following oxidation. [2]

In strengthening the techniques used, the intention was to study these variations with Raman spectroscopy, a technique with high chemical specificity for recognising different amino acid residues, with the aim of understanding more precisely where these variations occur [3]. Some of the characteristic peaks obtained by Raman analysis of a sample of albumin in phosphate buffer are shown in the spectrum in Fig. 1.

In the field of nanomedicine, the study of the chemical and conformational variations of albumin is very important because the different structure of the protein affects the way it binds to drugs or to the biomolecules it carries through the bloodstream. In addition, these variations could alter its stability and therefore its capacity to perform important functions. However, it cannot be ruled out that the way in which the structure changes may improve binding with certain types of molecules, an interesting factor in relation to the use of albumin in drug delivery.

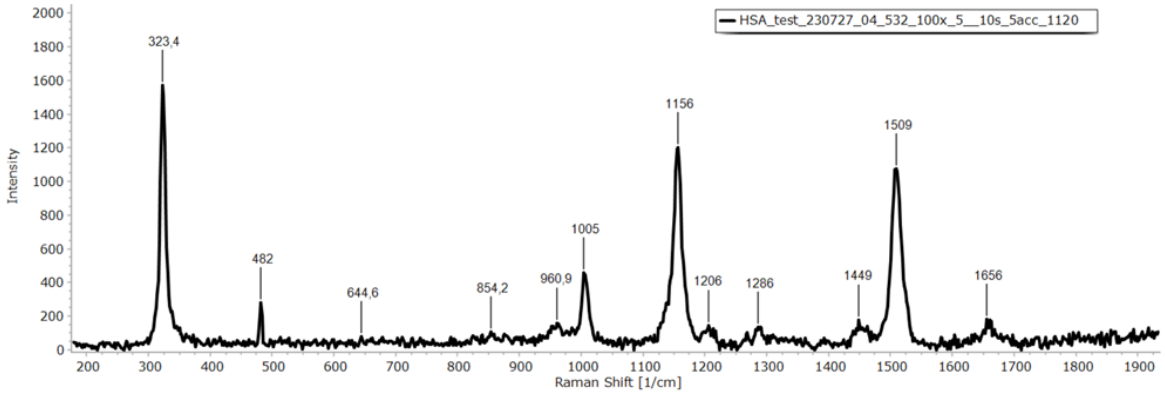

Figure 1. Raman spectrum of an albumin solution in phosphate buffer analysed in the range 180-1950 cm^{-1} with 532nm laser wavelength.

References:

[1] Peters, T.; *All About Albumin*, Elsevier, 1995; https://doi.org/10.1016/B978-012552110-9/50004-0
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[3] Dingari, N.C.; Horowitz, G.L.; Kang, J.W.; Dasari, R.R.; Barman, I.; *Raman spectroscopy provides a powerful diagnostic tool for accurate determination of albumin glycation.* PLoS One. 2012;7(2):e32406. doi: 10.1371/journal.pone.0032406. Epub 2012 Feb 29. PMID: 22393405; PMCID: PMC3290592.