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Homogenization of human tissues via picosecond-infrared laser (PIRL) ablation: Giving a closer view on the in-vivo composition of protein species as compared to mechanical

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Abstract: Posttranslational modifications and proteolytic processing regulate almost all physiological processes. Dysregulation can potentially result in pathologic protein species causing diseases. Thus, tissue species proteomes of diseased individuals provide diagnostic information. Since the composition of tissue proteomes can rapidly change during tissue homogenization by the action of enzymes released from their compartments, disease specific protein species patterns can vanish. Recently, we described a novel, ultrafast and soft method for cold vaporization of tissue via desorption by impulsive vibrational excitation (DIVE) using a picosecond-infrared-laser (PIRL). Given that DIVE extraction may provide improved access to the original composition of protein species in tissues, we compared the proteome composition of tissue protein homogenates after DIVE homogenization with conventional homogenizations. A higher number of intact protein species was observed in DIVE homogenates. Due to the ultrafast transfer of proteins from tissues via gas phase into frozen condensates of the aerosols, intact protein species were exposed to a lesser extent to enzymatic degradation reactions compared with conventional protein extraction. In addition, total yield of the number of proteins is higher in DIVE homogenates, because they are very homogenous and contain almost no insoluble particles, allowing direct analysis with subsequent analytical methods without the necessity of centrifugation. Biological significance Enzymatic protein modifications during tissue homogenization are responsible for changes of the in-vivo protein species composition. Cold vaporization of tissues by PIRL-DIVE is comparable with taking a snapshot at the time of the laser irradiation of the dynamic changes that occur continuously under in-vivo conditions. At that time point all biomolecules are transferred into an aerosol, which is immediately frozen.