aminoacyl-tRNA synthetase in response to an amber codon with high efficiency and fidelity. The site-specific incorporation of these UAAs was verified by SDS-PAGE and ESI-Q-TOF mass analysis. IR spectroscopy was then utilized to probe the protein hydration state for the azide group in these sfGFP constructs.

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The Effect of Selenium Treatment On-Diabetic-Induced Structural Variations in the Molecules of Rat Kidney Plasma Membrane

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Diabetes Mellitus is a metabolic disorder affecting the great amount of world's population, in which fat, protein and carbohydrate metabolism is severely affected by deficient insulin secretion or function. In this study, the Attenuated Total Reflectance Fourier Transform Infrared (ATR-FTIR) Spectroscopy was used to study diabetic kidney disease-induced structural changes, which encountered as a complication of diabetes. Furthermore, the protecting and possible therapeutic role of selenium in the course of diabetic kidney disease disclosed. The detailed spectral analysis of ATR-FTIR spectroscopy revealed that, protein and saturated lipid content of diabetic kidney plasma membrane prominently diminished. The decrease in the unsaturated lipid content indicates diabetes-induced lipid peroxidation. Nevertheless, the administration of selenium at low and medium concentrations improved the condition by changing the lipid and protein content to the normal values. The ordered structure of plasma membrane lipids due to diabetes turned back to healthy structure with the selenium treatment. The diabetes caused the decrease of membrane dynamics however; selenium treatment increased the dynamics of membrane. Hierarchical Cluster Analysis (HCA) and Principal Component Analysis (PCA) applied to the control, diabetic and selenium treated groups revealed clear separation of the groups with high heterogeneity in the lipid and protein spectral regions. These chemometric methods show that, low and medium dose selenium treated groups successfully segregated from diabetic group and clustered close to the control group which indicates recovery effect of selenium at these concentrations in diabetic animals. To conclude, lipid and protein structure and content of the diabetic kidney plasma membranes deteriorated, which restored after selenium administration, more preferentially at low dose. The results of the study suggest selenium treatment at appropriate dose may be related to insulin mimetic and antioxidant properties of selenium.

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A Novel Method for Early Diagnosis of Malignant Pleural Mesothelioma from Human Serum Samples: ATR-FTIR Spectroscopy

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Malignant pleural mesothelioma (MPM) is an aggressive and rare form of cancer which arises from environmental fibrous minerals (tremolite asbestos or erionite) exposures. Since it is difficult to differentiate the benign pleural thickenings from carcinomas, MPM can only be diagnosed in the advanced stage. Therefore, it is important to develop a new method with high specificity and sensitivity for the early diagnosis of MPM. Fourier Transform Infrared (FTIR) spectroscopy is a novel and non-invasive method that provides high specificity and sensitivity in the diagnosis of cancer. Moreover, FTIR with its attenuated total reflectance (ATR) tool is eminent technique because of its rapidity and ease to put into clinical practice. Hence, we used ATR-FTIR spectroscopy coupled with chemometric analysis methods to characterize the molecular alterations as well as to differentiate the experimental groups from each other. FTIR spectra of the samples collected from patients diagnosed with malignant pleural mesothelioma (MPM), lung cancer (MLC), benign, and healthy control (C) were recorded in the 4000-650 cm-1spectral region.. Recording the spectra and analysis of the spectral data were obtained with Perkin Elmer Spectrum One Program. Spectral analysis indicated a significant decrease in the lipid, protein, carbohydrates, and nucleic acid contents in MLC and MPM with respect to the healthy samples. Hierarchical Cluster Analysis (HCA) and Principal Component Analysis (PCA) were performed to differentiate the studied groups based on the spectral differences. HCA of the samples demonstrated that all studied groups successfully differentiated from the control. Moreover, successful clustering of the all groups (control, MLC, MOC, MPM) was obtained in the protein region (1900-1485 cm-1 and 3500-3010 cm-1) by PCA of serum samples.

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Investigation of Gender Effect on Obesity using a Model of Inbreed Obese Mouse Lines by Fourier Transform Infrared Imaging

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Lipid accumulation and storage of lipids in adipocytes during obesity cause structural and functional changes in adipose tissue conformation. The expansion of visceral (VAT) and subcutaneous (SCAT) adipose tissue mass in the body is the main reason of obesity and many times it results in disturbed lipid and glucose metabolism. Gender is an important factor for the research in obesity and other metabolic diseases because it leads to different fat distribution and the pathophysiology. This study aims to determine gender effect on the structural and functional parameters on VAT and SCAT. To achieve this, FTIR microspectroscopic imaging technique and UCP1 immunohistological staining have been used. FTIR microspectroscopy is a rapid and effective technique to monitor molecular alterations in biological tissues induced by different conditions such as disease, chemical treatment and variations in the environmental factors. UCP1 protein content gives information about the amount of brown adipose tissue (BAT), and therefore about the transdifferentiation of BAT to the white adipose tissue (WAT). The results of FTIR imaging study revealed a decrease in unsaturation level of lipids and an increase in the amount of triglycerides in adipose tissue samples. Furhermore, the longer hydrocarbon acyl chain length was obtained in the lipids of obese samples. All of these spectral paramaters could be used as biomarkers in obesity. The results of the present study showed that, these obesity indicators are more significant in SAT of female mice, whilst, they are more significant inVAT of male mice. The amount of UCP1 protein which is a marker of the transdifferentiation, showed a decrease in male samples rather than females. Consequently, obesity has adverse effects on health of both genders but especially on men.

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Measuring the Distribution of Taurine Molecule Inside Biological Tissue via Intrinsic Molecular Vibrations using Nonlinear Raman Spectroscopy

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Distributions of small molecular weight (less than 300 Da) organic compounds inside biological tissue have been obscure because of the lack of appropriate methods to measure them. Although fluorescence techniques are widely used to characterize the localization of large molecules such as proteins and nucleic acids, they cannot be easily applied to the cases with small molecule compounds: Fluorescent labels are relatively large compared to the target compounds and can interfere with the chemical properties of them. Raman spectroscopy is a technique to study vibrational information intrinsic to and characteristic of the chemical species of compounds. We used coherent anti-Stokes Raman scattering (CARS) spectroscopy to detect and identify a small molecule compound, taurine, in aqueous environment without labeling. Molecular species could be uniquely identified from the spectral shape of the broadband vibrational spectra of target compound. The local distribution of the compound could be determined from the spectral intensity. We have developed a phase-sensitive CARS spectroscopy capable of measuring the broadband spectrum simultaneously without losing high frequency resolution. We also utilized a time-resolved technique to remove non-resonant noise signals over a wide spectral range produced by water molecules. We combined these techniques to selectively detect resonant vibrational CARS signals from a target compound. We measured taurine inside mouse cornea tissue soaked in solution as an initial model experiment. We detected a Raman peak of taurine near 1000 wavenumber / cm inside cornea, and successfully characterized its depth profile in the tissue. Our CARS spectra measurement can be a promising method to measure and visualize the distribution of small bio-related compounds in biological background without using any labeling, paving the way for new cell biological analysis in various disciplines.