Aquaphotomics: Introductory Course

Roumiana Tsenkova

rtsen@kobe-u.ac.jp

Aquaphotomics stands for **Aqua**(water)**Photo**(light)**Omics**(all about). It is complimentary to all existing –omics disciplines investigating single molecules or systems in the same way as water is the complimentary environment for all biological and aqueous systems. Water is a 4-dimensional molecular network that changes its hydrogen bonded conformation structure as a mirror of physical and chemical changes in the respective system or its surroundings over the time. Water absorbs, at different degree, energies from all over the electromagnetic spectrum. Thus, it can be measured in real time using all kinds of spectroscopy. Spectroscopy and multivariate data analysis are the main tools used in aquaphotomics. The aim of aquaphotomics is to utilize the holistic role of water for understanding the system functionality. Aquaphotomics uses the water spectral pattern defined under certain perturbation as holistic biomarker directly related to respective system functionality.

The concept of Aquaphotomics[1] has been presented for the first time in 2005 at the International Conference of Near Infrared Spectroscopy (NIRS) held in New Zealand. It was inspired by the finding that the light absorbance of raw cow's milk at specific water absorbance bands curved different characteristic spectral patterns for healthy and diseased animals, respectively. Further on, biological systems, from DNA water solutions, cells, plants, animals to humans have been non-invasively analysed with NIRS under various perturbations and it was proven that specific water spectral patterns mirror the system's chemical and physical state.

In this course, examples of various biological and aqueous systems, from single molecules in water, cells, bacteria, whole plants to animals that have been subjected to various perturbations and biomonitoring in order to acquire their near infrared spectra, non-invasively and in real time over a certain period of time will be discussed. Systems have been subjected to near infrared multivariate spectral analysis where near infrared light penetrates into the water and the living tissue and interacts with the water molecular system there. The results have shown that physiological abnormalities have changed the spectra in a respectively systematic way. Specific water spectral patterns have been found to be characteristic for certain diseases. Further on, combination of specific water absorbance bands, called Water Matrix Coordinates (WAMACS) have been related to system functionality. Assignment table with water absorbance bands that have been experimentally discovered, theoretically proven and found to be related to various water molecular conformations will be provided.

Reference

1. Tsenkova, R., (2009) Introduction Aquaphotomics: dynamic spectroscopy of aqueous and biological systems describes peculiarities of water, J. Near Infrared Spectroscopy 17 pp303-313.