Aquaphotomics for investigating water physics and functionality

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Summary:

The Water Research Lab in Heidelberg has been set up at the end of 2017 to investigate water physics of ultra-high dilutions, one of the methods used is near-infrared spectroscopy with aquaphotomics approach.
In this abstract, previous work performed at ViaLight Research will be shared about investigating the effect of a 'water vitalizing device' using a specific temperature perturbation protocol. Results showed reproducible difference in the absorption spectra between Control and Activated water, showing the potential of using aquaphotomics for aiding in design and quality monitoring of such devices.

Introduction:

The aim was to investigate the effect of a 'water vitalizing device' on water functionality. The 'water vitalizing device' concerned does not use explicit chemical additions or external electronic devices to induce changes to the water. Over some years, various approaches were pursued, including tests in agriculture, on humans, and on water itself. In each case tap water before going through the 'water vitalizing device' (Control) was compared to tap water after having gone through the 'water vitalizing device' (Activated). In this abstract, the focus will be on the aquaphotomics experiments.

Method:

Equipment used: Near-infrared spectrometer (900-1700nm range NIRQuest512 Ocean Optics), temperature controlled cuvette holder with water bath (QPod 2e, Ocean Optics), 1mm Quartz/suprasil cuvette (Hellma Analytics), halogen lamp (HL-2000-HP-FHSA, Ocean Optics), 2 optical fibers (600um Premium Fibers, VIS/NIS, 2m, BX Jacket (KB), Ocean Optics)

Device settings: Absorbance mode, 23ms integration time, 64 scans, non-linearity correction

Measurement protocol: Samples were first filtered with 0,2 um filter in order to reduce biological contaminants potentially influencing the light absorption. Before starting a measurement, air reference was made, cuvette rinsed three times with distilled water, 3 times with sample and then filled with sample (380ul), then sample was cooled to 2 degrees (for 8 minutes) in temperature controlled cuvette holder. In between each stored spectrum (which is an average of 64 scans, each with integration time 23ms) the shutter of the halogen lamp was closed and opened. The following temperature steps were taken in degrees Celsius: 2, 3, 4, 5, 10, 15, 20, 25, 30, 33, 35, 36, 37, 40, 41, 42, 45, 46, 50 and back. On the upward slope 80 consecutives were taken and on the downward slope 120 consecutives were taken. The total measurement time was approximately 3 hours. The order of the Control and Activated was changed between measurement days.

Experiments:

1. Effect over time in water (from tap 1) for a certain tapping date: 2 tapping dates, each 4 times
2. Effect in very old water (from tap 1): 1 tapping date, 2 times
3. Effect of other tap water (from tap 2): 1 tapping date, 4 times
4. Effect of component X (from tap 1): 1 tapping date, 2 times
5. Effect of component Y out (from tap 1): 1 tapping date, 2 times

Analysis:

Raw spectral data was smoothed (5) and EMSC corrected (default setting, mean of data) using Solo (stand-alone chemometrics software based on PLS_Toolbox, EigenVector Research Incorporated) before calculating the aquagram values at the 12 main WAMACS according to the following formulas:
$(Control)_\lambda = ((AVG\ Control)_\lambda - (AVG\ all)_\lambda)/ (SD\ all)_\lambda$
$(Activated)_\lambda = ((AVG\ Activated)_\lambda - (AVG\ all)_\lambda)/ (SD\ all)_\lambda$
Similary, more aquagrams were made for each specific temperature step.

Results:

In experiments 1, 2, and 3 Activated water showed a reproducible different result than Control around 1364 nm. More particularly, with increasing temperature Control water seems to reduce absorption at 1364nm faster than Activated water. According to the current water molecular system assignments used in aquaphotomics, 1364 nm is related to the 'water solvation shell'. This finding could mean that Activated water is able to keep the 'water solvation shell' longer than Control water with increasing temperature, possibly telling something about the strength of this shell, and perhaps related to a different functional effect, particularly related to better solving of compounds, therefore more reactive and more 'energetic/ active'. This indication about functionality was supported by the results of test in agriculture and on humans.

Experiment 1 showed a similar result for two different tapping dates measuring over time (4 times within a month of tapping).

Experiment 2 showed that nine-month old Activated and Control water provided similar results.

Experiment 3 showed that different incoming tap water also showed similar results.

Experiment 4 showed that leaving out an essential component of the 'water vitalizing device' did not show the same results, which indicates the effect of that component.

Experiment 5 showed that leaving out component Y (within component X) of the 'water vitalizing device' showed an opposite effect, therefore indicating that it was not necessary in the construction of the device.

Recent measurements showed that three years later, the 'water vitalizing device' still showed similar aquagrams, indicating that the device still performed as expected.

Conclusion:

The presented aquaphotomics based temperature perturbations protocol has potential to provide information about water functionality and aid in 'water vitalizing device' design and quality monitoring.

Another application that is currently pursued (with different protocols) is to build up a database of mineral waters around the world to provide information to consumers and water companies about the water, effects of storage conditions, handling, and more.

And, at the Water Research Lab, near-infrared spectroscopy with aquaphotomics approach is applied to investigate more fundamental questions related to the physics of water.