Laboratoire de Biochimie Théorique
Institut de **B**iologie **P**hysico-**C**himique
13, rue Pierre et Marie Curie
75005 PARIS

S E M I N A I R E

Pavel Jungwirth
Institute of Organic Chemistry and Biochemistry, Academy of Sciences of the Czech Republic, Flemingovo nám. 2, 16610 Prague 6, Czech Republic
E-mail: pavel.jungwirth@uochb.cas.cz

« Sweet taste of heavy water »

Heavy water (D2O) differs from normal water (H2O) by H-D isotopic substitution only and, as such, should not be chemically distinct. Leaving aside a trivial 10% change in density due to the doubled mass of D compared to H, differences in properties of D2O vs H2O, such as pH or melting and boiling points, are indeed very small. These differences are solely due to nuclear quantum effects, namely, changes in zero-point vibrations, which lead to a slightly stronger hydrogen bonding in D2O than in H2O. Despite the fact that the two isotopes are nominally chemically identical, we have shown conclusively that humans can distinguish by taste (which is based on chemical sensing) between H2O and D2O with the latter having a distinct sweet taste. In our work, we complement taste experiments on human subjects with tests on mice and on HEK 293T cells transfected with the human sweet taste receptor TAS1R2/TAS1R3, and with molecular modelling. The results consistently point to the fact that the sweet taste of heavy water is mediated in humans by the TAS1R2/TAS1R3 receptor. Future studies should be able to elucidate the precise sites and mechanisms of action, as well as the reason why D2O activates TAS1R2/TAS1R3 in particular, resulting in sweet (but not other) taste. While clearly not a practical sweetener, heavy water provides a glimpse into the wide-open chemical space of sweet molecules. Since heavy water has been implicated in medical procedures, the finding that it can elicit responses of the sweet taste receptor, which is located not only on the tongue but also in other tissues of the human body, represents an important information for clinicians and their patients. Moreover, due to wide application of D2O in chemical structure determination, chemists will benefit from being aware of the present observations. Finally, it is fascinating that one can actually taste nuclear quantum effects.

References:
1.Abu N.B., Mason P.E., Klein H., Dubovski N., Shoshan-Galeczki Y.B., Malach E., Pražienková V., Maletínská L., Tempra C., Chamorro V.C., Cvačka J., Behrens M., Niv M.Y., Jungwirth P.: Sweet taste of heavy water.Communications Biology4(2021) 440.

2. Cruces Chamorro V., Tempra C., Jungwirth P.: Heavy Water Models for Classical Molecular Dynamics: Effective Inclusion of Nuclear Quantum Effects. Journal of Physical Chemistry C125(2021) 4514.

Jeudi 2 juin 2022 à 14h00 - Salle de conférence