Towards chemical unraveling of odorous tap water: An in-depth analysis of odor-causing organic trace compounds in the Flemish drinking water distribution network

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Abstract
Drinking water providers sometimes receive complaints about taste and odor (T&O) in the drinking water. As consumers experience a negative quality and safety perception, they often choose bottled water instead of tap water. However, the production, distribution and consumption of bottled water have a substantial environmental impact, primarily due to their high energy consumption (1000-2000 times higher than that of tap water) and plastic waste generation (Geerts et al., 2020; Qian, 2018).

The underlying cause of a substantial proportion of T&O complaints received by drinking water providers remains unknown. Although microbiological and physical-chemical processes have been suggested to have an influence on T&O deviations during the storage and distribution of drinking water, this causality remains unclear. Therefore, it is important to identify and quantify these T&O compounds and get insights into their formation pathways. Most literature has focused on the (analysis of the) well-known T&O compounds geosmin and 2-methylisoborneol, but not every problem can be linked to these. The major challenge is that T&O compounds are numerous and at least partially unknown, and can be perceived already at very low concentrations (low $ng.L^{-1}$ range), which makes their analysis highly challenging. The characterization of perceived taste and odors in drinking water is also a complex task, and the T&O wheel proposed by Suffet et al. (1999) can serve as a valuable tool to facilitate this process by providing a comprehensive framework for describing these sensory attributes.

Based on this, a novel analytical method targeting 45 T&O compounds, representing the eight odor categories of the T&O wheel, at trace concentrations was developed making use of stir bar sorptive extraction followed by thermal desorption gas chromatography mass spectrometry. Prior to validation, different parameters such as extraction time, stir bar sorbent volume, water volume, and desorption conditions (temperature, time, flow) were experimentally optimized.

Driven by recurring customer complaints regarding drinking water quality, the newly developed multi-compound method was applied to investigate odor-related case studies in the distribution network of Flanders, in collaboration with the drinking water companies. We will present a unique field case study investigating the impact of mixing ground- and surface derived drinking waters on (variations in) T&O profiles.

References

Geerts, R., Vandermoere, F., Van Winckel, T., Halet, D., Joos, P., Van Den Steen, K., Van Meenen, E., Blust, R., Borregán-Ochando, E., & Vlaeminck, S. E. (2020). Bottle or tap? Toward an integrated approach to water type consumption. *Water Research*, *173*. https://doi.org/10.1016/j.watres.2020.115578

Qian, N. (2018). Bottled water or tap water? A comparative study of drinking water choices on university campuses. *Water (Switzerland)*, *10*(1). https://doi.org/10.3390/w10010059

Suffet, I. H., Khiari, D., & Bruchet, A. (1999). The Drinking water taste and odor wheel for the millennium: beyond geosmin and 2-methylisoborneol. *Water Science and Technology*, *40*(6), 1–13. https://www.new-oceans.co.uk/new/wheel2.htm