Editorial: Linking tastes, odours, and appearance of water with consumer perception

This issue presents an excellent collection of global articles from the 10th International Symposium from the International Water Association's Specialty Group on Tastes, Odours, and Algal Toxins in Drinking Water Resources and Aquaculture (formerly called 'Off-Flavours in the Aquatic Environment'). The symposium was held at National Cheng Kung University in Tainan, Taiwan during October 2013. The articles have all been written and peer reviewed according to the journal's high standards.

The authors of the articles originate from Asia, Australia, Europe, and North America. While the researchers are from across the globe, their individual research has universal application for drinking water sustainability and public health protection. The articles intertwine two important aspects of tastes and odours in drinking water: (1) the complex nature of human sensory perception; and (2) the complex role of algae, ecology, and limnology in production of tastes, odours, colour, and turbidity in source and drinking waters. The human senses are an interface designed to assess the environment and determine pleasures and risks. As is done for any food or beverage, consumers apply their senses to evaluate treated drinking water to determine its acceptability and desirability for human consumption. Sensory science is revealing that human thresholds for tastes and odours are similar across the globe, while human preferences and acceptability of specific tastes, odours, or appearance vary among cultures and geographic locations. Because of the role of sensory perception in determining the quality of drinking water, drinking water providers must consider consumer perception, satisfaction, and feedback as important indicators for drinking water quality.

There are four articles on studies that assess human perception using both consumers and trained personnel. 'Rethinking aesthetic guidelines for manganese and iron in drinking water' (Sain & Dietrich 2015) demonstrates that humans can often perceive colour, taste and/or odour at concentrations below current regulatory guidelines for these two major metals that cause aesthetic water quality problems in both source and drinking water. Likewise, human perception of the major odourant in disinfected water worldwide is the research topic of 'Evidence of regional differences in chlorine perception by consumers: sensitivity differences or habituation?' (Piriou *et al.* 2015). This research demonstrates that consumers who routinely drink chlorinated drinking water find the chlorinous flavour more acceptable than consumers who do not drink chlorinated water. The relationship of sensory perception and human physiological response is reported in 'Construction of an individualized sensory space of tastes in water using skin blood flow responses' (Haese *et al.* 2015). The research reveals that physiological measurements enable the discrimination of different tastes. The nuanced relationship between historical consumer complaints and actual consumer ratings of drinking water flavour in the presence of geosmin, 2-methylisoborneol, or chlorine as acceptable or unacceptable is reported in 'Taste and odour and public perceptions: what do our customers really think about their drinking water?' (Webber *et al.* 2015). Together, these four articles advance the understanding of how to establish regulatory limits or aesthetic guidelines to be consistent with consumer expectations and assessment.

Five articles evaluate the role of algae and cyanobacteria in the production of odourants that are perceptible and undesirable to consumers. Collectively, these studies were performed in water sources that provide drinking water to millions of consumers. The articles advance the ability of drinking water providers to manage water supplies to minimize odours, and thus promote consumer satisfaction. The article, 'Release behavior of odor contaminants derived by *Microcystis aeruginosa* in rivers and a non-strict anaerobic aqueous system' (Ma *et al.* 2015) demonstrates that *M. aerouginosa* primarily releases the odourous metabolites β-cyclocitral and β-ionone under low oxygen conditions. The article, 'Occurrence of algae and algae-related taste and odour (T&O) compounds in the Qingcaosha Reservoir, China' (Zhang *et al.* 2015) examines temporal and spatial variation in the concentrations of algae and cyanobacteria and the production of associated T&O compounds of dimethyltrisulfide (DMTS), 2-methylisoborneol, geosmin, and

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β-cyclocitral. A survey of 239 drinking water plants in 'Nationwide survey of organism-related off-flavor problems in Japanese drinking water treatment plants (2010–2012)' (Kishida *et al.* 2015) revealed that earthy-musty and fishy odours were the most common algae and/or cyanobacteria created odours in Japan and that most water treaptment plants use powdered activated carbon for controlling tastes and odours. Through applying 16S ribosomal DNA analysis, the organism responsible for production of 2-methylisoborneol in two rivers was revealed to be *Phormidium autumnale* in the article 'Musty odor producing benthic cyanobacteria in Tama River (Japan) and identification of species by genetic analysis' (Oikawa *et al.* 2015). While a global focus has been geosmin and 2-methylisoboneol since they are common global cyanobacterial odours, the article 'Odorant screening and possible origin analysis of odor episodes in one reservoir in north China' (Li *et al.* 2015) indicated that pyrazines and aldehydes, as well as trace levels of ketones and thiols, possibly from diatoms, were the cause of problematic odours in surface waters rather than geosmin and 2-methylisoboneol.

This *Journal of Water Supply: Research and Technology – AQUA* issue stresses that acceptable drinking water results from an interaction between drinking water providers and their consumers. An important focus for this interaction is emphasis on aesthetic qualities, which are the primary qualities that consumers use to assess drinking water quality, safety, and satisfaction. In the 21st century, water treatment professionals across the globe must integrate source water management, engineered water treatment, public health, sensory perception, and consumer satisfaction to produce acceptable drinking water that is safe and palatable for human consumption.

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