

# An Introduction to this Special Issue: Chemosensation and Health

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Relationships between the chemosenses, ingestive behaviors, food choice, and other health-related behaviors have long interested researchers across many fields (e.g., Fischer et al. 1963; Kang et al. 1967; Kaplan et al. 1964; Pangborn and Simone 1958). Indeed, rather than being “lower order” senses relative to vision and hearing, the chemosenses provided fertile soil for integrative, translational, transdisciplinary research (e.g., Barker 1982; Kare and Maller 1967) long before it was en vogue to speak of research in these terms. A prime example is the work by Kaplan and colleagues showing a link between genetic differences in taste perception and tobacco use (Kaplan et al. 1964). Other seminal work in this area includes a truly epic study by Pangborn and Simone from 1958: after collecting sweetness preferences in real foods from over 12,000 individuals, they failed to find any relationship with body size (Pangborn and Simone 1958), suggesting the putative role of a sweet tooth in obesity may be a myth, albeit one that remains controversial today. Indeed, subsequent work on liking and intake has implicated fat rather than sweet foods in obesity risk (i.e., Drewnowski et al. 1985; Macdiarmid et al. 1998).

Given such a rich history, this special issue of *Chemosensory Perception* continues the exploration of connections between human chemosensation and health across a wide array of fields and, in doing so, highlights specific implications for chemosensory researchers, health care providers, as well as public health. Four of the articles in this

special issue are targeted reviews that cover a wide range of topics within the realm of chemosenses and health, while the remaining two articles are original research articles containing novel data.

Excessive sodium intake is a threat to public health in the developed world. The primary source of dietary sodium comes from processed foods themselves rather than being added at the table or during cooking (James et al. 1987; Mattes 1990). Accordingly, the US Institute of Medicine (IOM) released a guidance document (IOM 2010) 5 year ago that recommended gradual stepwise “stealth” reduction of the amount of sodium in foods as a means to reduce overall sodium intake, under the belief that consumer preferences would eventually shift to match reduced sodium levels in the diet. However, as Nuala Bobowoski highlights in her review (Bobowski 2015), this assumption has never been directly tested. Nuala’s article succinctly reviews what is known about the ontogeny of salt preferences, the role of prior experience, and the gaps in current knowledge with regard to our ability to shift salt preferences over time.

The alterations of sensory function and shifts in food preferences that accompany cancer treatment are well known to anyone who has gone through treatment personally or watched a family member undergo treatment, at least anecdotally. Unfortunately, the training that oncologists and other allied health professionals receive in chemosensory biology and psychology is often very cursory, with the potential to influence the patient’s will to withstand these necessary but challenging treatments. The second article in this issue is an expert commentary on chemosensation and sensory science within the context of cancer treatment (Boltong and Keast 2015). In this commentary, two experts in their respective fields—Anna Boltong and Russell Keast—open with the observation that health care providers are often confused by the terminology and jargon used by chemosensory researchers (e.g., taste

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versus flavor). Perhaps more critically, the authors also note this confusion is further compounded in clinical settings by a failure to distinguish true changes in sensory function from affective or hedonic shifts that are known to accompany cancer treatment. To address this confusion, they first provide clear definitions of core concepts, before presenting two theoretical frameworks to help clinicians conceptualize relevant issues. To help translate chemosensory knowledge to the clinic, they highlight the importance of patient self-report in conjunction with targeted questioning to help the clinician isolate the specific problem so that the patient's needs can be adequately addressed. They also emphasize the need for good anticipatory guidance from the clinician to help the patient successfully navigate the cancer treatment process.

The third article in this issue tackles a problem many of us, even those of us who work in the chemosenses every day, likely have not considered previously. Here, Donna Scarborough and Cathy Pelletier address the role of the chemosenses as they relate to swallowing, and swallowing disorders (Scarborough and Pelletier 2015). They first review the complex sequence of events that underlie swallowing, a process that most of us take for granted, before delving into changes across the lifespan. With respect to translation, they note chemesthetic stimuli like carbonation or concentrated citric acid appear to be beneficial for swallowing safety in individuals with dysphagia; unfortunately, these stimuli are poorly tolerated by these individuals, limiting their utility. As noted by the authors, work in this area to date is relatively limited, with much still to be learned.

Pungent spices are widely and heavily consumed in many cuisines around the world, and interest in cuisines that contain these spices has steadily increased in western countries over the past two decades. Besides their important role in food flavor (Rozin 1983), it is now becoming apparent many of these spices may be bioactive in their own right (e.g., McCrea et al. 2015), with the potential to influence health and mortality (Lv et al. 2015). In the fourth article in this issue, Mary-Jon Ludy, Robin Tucker, and Sze-Yen Ten review the role of pungent spices in modulating food intake (Ludy et al. 2015). As is only appropriate given the scope of this issue, they limit themselves to work in humans that involve some degree of oral or nasal exposure, excluding trials where the spices are encapsulated or otherwise prevented from eliciting chemosensory responses. As pungent spices may potentially enhance or suppress intake, they cover both in their review, beginning with the former. Within each section, they provide detailed summaries that emphasize what is known, highlighting when this knowledge and clinical practice do not align.

Each year, the National Health and Nutrition Examination Survey (NHANES) is administered by the Centers for Disease Control and Prevention to a nationally representative sample of 5000 free-living individuals who range in age from birth to 80+ years. This effort dates back to the first NHANES I study

conducted between 1971 and 1975, with follow-up studies from 1976 to 1980 and 1988 to 1994 (NHANES II and III, respectively). Since 1999, NHANES shifted to a continuous design, where it provides a demographically weighted snapshot of the health and nutritional status of adults and children in the USA. The current NHANES study collects data via home-based interviews and a mobile exam facility staffed by trained medical personnel. The collected data includes demographic, socioeconomic, dietary, and health-related questions, as well as medical and dental exams, dietary interviews, and laboratory tests. After many years of effort spearheaded by Howard Hoffman and Barry Davis at the National Institutes of Deafness and Communications Disorders, with guidance from many other experts in the field, the NHANES team added a taste and smell exam component ([http://www.cdc.gov/nchs/data/nhanes/nhanes\\_13\\_14/Taste\\_Smell.pdf](http://www.cdc.gov/nchs/data/nhanes/nhanes_13_14/Taste_Smell.pdf)) to the battery of tests conducted in the mobile examination center. In the fifth article in this special issue, Valerie Duffy and her team at UConn, in collaboration with Howard Hoffman, describe the results from a laboratory-based validation study of the NHANES taste and smell protocol in a convenience sample of adults (Rawal et al. 2015). They find that in spite of being a brief screening measure intended for epidemiological level data collection, the exam protocol both provides data that agrees with more extensive laboratory testing and has reasonable test-retest reliability over 6 months. As the newest wave of NHANES datasets become available to the public, the inclusion of valid, objective chemosensory tests can only help facilitate the exploration of new relationships between chemosenses, diet, and broader health.

The final article in this special issue contains original data from my laboratory at Penn State, with Alissa Allen Nolden as the lead author. Although the connections between the chemosenses and alcohol use, misuse, and abuse have long been studied (Kang et al. 1967; Mattes and DiMiglio 2001; Peeples 1962), we discovered a surprising gap in the literature when we went searching for reports on the change in perceptual quality of ethanol across concentrations that are ecologically relevant to alcoholic beverages. Here, in a convenience sample of adults who do not abstain from alcohol, we show that while sampled ethanol is simultaneously bitter, burning and sweet—as is readily apparent to anyone that has ever sipped neat vodka—the predominant sensation varies significantly across concentration, with bitterness dominating at lower concentrations, while burn dominates at higher concentrations (Nolden and Hayes 2015). Additionally, these data indicate that self-reported alcohol intake frequency outside the laboratory associates with individual differences in the sensation from straight ethanol (as opposed to alcoholic beverages, which also contain other sensory active components). This work contributes to a growing body of evidence that variation in chemosensation may differentially influence alcohol use

(Dotson et al. 2012; Duffy et al. 2004; Hayes et al. 2011) and possibly misuse (Pelchat and Danowski 1992).

In closing, I would like to sincerely thank the journal editor in chief, Jeannine Delwiche, for giving me the opportunity to be the guest editor for this special issue, as this topic is very important to me. Also, I need to strongly thank the authors of all of the articles included here, as well as all the anonymous reviewers that reviewed these articles. I can only hope that this special issue stimulates additional interest in and work on the translation of the chemosenses out of the laboratory, into the clinic, and the public health arena.

Cheers!

John E. Hayes

**Compliance with Ethics Requirements** This article does not contain any studies with human participants or animals performed by any of the authors.

**Conflict of Interest** JEH has previously accepted speaking and/or consulting fees from industrial clients for unrelated projects, and he has also served on the Scientific Advisory Board of Medifast, Inc. His laboratory at Penn State also conducts routine taste tests for the food industry to facilitate experiential learning for undergraduate and graduate students. None of these organizations have had any influence over the conception, interpretation, or the decision to publish the information presented here.

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