To the Bitter End

Affect, Experience, and Chemical Ecology

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Abstract This article explores taste in its chemical, gustemological and affective senses, asking what we speak of when we talk about "bitter experience." Drawing lines of connection between human affect and chemical ecology, it suggests a way of thinking about taste as a chemical entanglement of affective qualities and ecological relations. Two observations underpin the argument. First, the ambiguous resonance of bitter-tasting compounds in human culture is grounded in their ambiguous medical meaning, the same drug may serve as poison or cure. Second, plants interact with many other life-forms by producing chemical compounds, many of which are bitter tasting, that have effects on the metabolisms of the organisms around them. These *secondary metabolites* have become entangled in human physiology and culture. The use of bitter-tasting plants in food and medicine requires specialised technical knowledge for identification, processing and dosing, a necessity that expresses itself in various yet comparable cultural responses to bitterness. A number of cultural traditions hold strong associations between embitterment, wisdom, healing, and remembrance. In these similar responses to bitterness, the article suggests that there is an ecological and affective resonance that might be located in the idea of bitter experience.

Keywords bitterness, medicine, taste, affect, experience

Introduction

This article draws lines of connection between personal and social affect and interspecies chemical communication. It takes the quality of bitterness tastes as its central motif. Using the mode of a reflective essay, it asks the speculative question; if there were such a thing as *bitter experience*, what would shape it? Developing this theme, it offers a thick account of taste and chemical ecology; drawing on insights and evidence from ethnography, ethnobotany, philosophy and herbal medicine. Bitter compounds and bitter emotions are characterised by toxicity and danger, the opening discussion presents an epistemology of experiential "taste knowledge" that stresses the danger and value of bitter experience. Thinking about the physiological action of bitter compounds on the human body draws further attention to taste as an immanent manifestation of chemical communication. In culinary practices that mix affect and healing, the value of practical knowledge of bitterness as well as responses to bitterness are embedded within the body. The final part of the article considers examples in the ethnographic literature and herbal medicine where skilled practical negotiations of bitterness are overlapped by affective narratives that stress themes of healing and remembrance. Taken together, these various treatments of bitterness offer an expanded sense of taste as a relational quality in both interpersonal and interspecies realms.

A narrative arc from the author's previous research (Drayson 2019) reflecting on how the affective and material dimensions of sugar connect sweetness, honesty, love, and healing is continued here. Responding to figures of speech in the English vernacular that commented on the use of sugar coatings to dupe patients and lovers, it connected "folk" knowledge of love and honesty to the aesthetic qualities of medicines. It followed a hunch that figures of speech might signpost forms of pre-reflective and embodied phenomenological "felt meaning" (Petitmengin 2013). In the case of

metaphors surrounding bitter medicine there is a pervading sense that what is healthful is not always pleasing to the senses. The English vernacular reflects on the problem of accepting or "swallowing" what is unpleasant: we "take our pills with jam," or a "spoonful of sugar;" some bad news or experience is a "bitter pill to swallow." As Highmore (2010) points out, the language of affect in common English usage tends to lace together the sensual and physical with the languages of emotion:

> "[W]ords designating affective experience sit awkwardly on the borders of the material and the immaterial, the physical and the metaphysical [and] makes it hard to imagine untangling them, allotting them to discrete categories in terms of their physicality or their ideational existence" (*ibid.* 120f).

Bearing this untidiness in mind, focussing specifically on bitterness might be seen to overlook calls in sensory anthropology to move away from the treatment of the senses as distinct modes, sight, touch, taste, etc. (Porchello 2010: 55). One reason to avoid this is that it carves up the sensorium according to physiological science, at the expense of the phenomenological, experiential accounts of individual experience. It also overlooks the synaesthetic nature of even the most everyday sensory experience and the capacity for "transcription and translation across the senses" (Seremetakis 2017: 249). It would seem that this failing is doubled in the current focus on a single taste when it is so clear that gustatory experiences result from the complex interplay of many sensory modalities including olfactory, chemical and haptic senses. Looking to a single sense, and a single taste modality can certainly seem excessively reductive. But the goal is to try to keep the narrow quality "bitterness" alive in as many senses as possible at the same time, to ask with Highmore (2010),

> "does the emotional condition of bitterness, for instance, release the same gastric response as the ingestion of bitter flavors? How do we make our way from one modality to another?" (*ibid.* 120)

The answer, he suggests, is not to try to disentangle these modes but to draw on the affect studies approach that understands these as a "nexus of finely interlaced force fields" and "build on the intuition that cultural experience is often a densely interwoven entanglement" (*ibid.*).

The trope of bitter experience is offered then as an entangling theme as we make our way between detailed disciplinary knowledge areas and varying ontological categories. In particular it makes space to consider bitterness' connection to interspecies relations. In recent decades a posthuman turn has led to a tendency in many fields to attempt to account for the human as emergent through its relations with other organisms. *Non-human* or *more than human others*—bacteria, viruses, plants, and animals and their entanglements now offer foci for works of "multispecies ethnography" which offer a

> "mode of attunement to the power of non-human subjects to shape the world and the ways in which the human becomes through relations with other beings" (Ogden *et al.* 2013: 12f).

A number of imperatives have inspired this shift of attention, many of which are political and environmental. Insights from the biosciences into the complex biological interdependencies between lifeforms has invited reconsideration of the fixity of both bodies and species (*ibid.* 14); a "rhizomatic zeitgeist inflects many branches of biology. And anthropology is infected too" (Kirksey & Helmreich 2010: 555). Specifically relating to plants, research in chemical ecology, including studies of plant-insect communication and allelopathy, biochemical communication between plants (Cheng & Cheng 2015) demonstrates a compelling relational world of chemical entanglements, raising questions of vegetal perception and agency (Myers 2015). In its concern with chemical ecology, and the chemical sense of tastes, this article follows in this turn of attention to the non-human, by speculating on the shaping of affect by the imperatives of interspecies and interpersonal relations. There is some resonance here with Hustack and Myers' (2012) coining of the term "affective ecology"(*ibid.* 79) to describe the affective entangling of orchids and bees (and researchers who seek to understand them). However the goals here are somewhat more modest in their attention to the human phenomenal world, seeking to consider where plant agency and plant "talk" might manifest in human cultural and affective tropes.

At its centre it seeks to think of the act of tasting as an engagement with a relational and ecological-chemical space that is shaped by an *embodiment* that emerges from a material, intentional and living world. Considering taste in this way can map a familiar sensory world with an evolutionary history of chemical and technical co-evolution that is the result of entangled non-human and human agencies.

Bitter Experience

In its colloquial English meaning, a "bitter experience" is one that we learn a hard lesson from. Bitterness' ambivalence leads us to consider arguments about experience and the senses as a source of knowledge. Historian of psychology Edward Reed (1997) has argued that modern life has become increasingly reliant on mediated experiences and theoretical knowledge. This is at the expense of "primary" experience—what we can see, feel, taste, hear, or smell for ourselves—a lack of which Reed suggests has serious implications for our mental abilities. Because the intellectual cultures of western philosophy and psychology "seriously underestimate the value of experience" (*ibid.* 158), primary experience has been increasingly thought of as an unreliable source of knowledge; a view that has had a pervasive influence on many aspects of life, work and education. Reed draws on John Dewey's arguments that theory has been elevated over practice partly for reasons of convenience: "practical activities are dirty, often dangerous, repetitious and impermanent" whereas the realm of ideas is "separate from the everyday world in which things rot or break" (*ibid.*) A hierarchy in which practical activities rank as lower, as earthy, bodily and material, justifies and allows those in power the ability to avoid (at least when it suits them) the unpleasantness and recalcitrance of a world that provides friction and disappointment, where things spoil or poison and create physical and bodily wear and tear. A world of danger that is, in the end, finite. While we can learn from what Reed calls "secondary experience," the potential information contained within a representation is extremely limited in comparison with the complexity of direct engagement with the entity or environment it is intended to represent – he compares a photograph of a person with an actual person. Taking an approach from ecological psychology, which considers the environment and experiences within it an inherent part of an organism's mental life, Reed suggests that the consequences of limited primary experience are stark. A lack of interaction with complex entities and environments is a lack of opportunity to develop the resources with which "to experience the world around us accurately and to use this experience to think carefully" (*ibid.* 158). They amount to an impoverishment of the ability to think with the materials of the physical world rather than representational structures.

Reed's thoughts point to two aspects of knowledge about or gained through taste. First, that of the dangers or difficulties of arriving at it, and second that it might offer something we could think with. As one of the three main chemical senses, taste is anchored in the body. Its corporeal immanence attaches it to risk. In their philosophy of taste and eating, Bosivert and Heldke (2016) cite the fearful English phrase "does this taste funny?"—a phrase which for them epitomizes taste's immanence and danger. It stresses the high stakes of tasting, and the close contact it requires us to have with its objects. As they point out, to know through tasting involves danger, intimacy, sustenance, and potentially, pleasure. Ingestion puts us into direct and necessary contact with the world; "stomachs keep us involved—invested—in our surroundings" we have to eat, even though it "calls us to risk; to be open and to learn to act with less certainty than we would like" (*ibid.* 108). They argue that an epistemology of taste demands radically different approaches to knowledge and exploration to that of sight. Unlike visual knowledge's privileged safe distance, what we ingest has consequences, an epistemology of taste leans toward an ethics that stresses pragmatic and embodied concerns; "eating reduces the gap between us and the rest of the world" (Bosivert & Heldke 2016: 107). In some sense it erases that gap; to eat something is to allow it to cross a boundary and enter the body. For better or worse, to know something through taste is to be changed by it.

Bitter Physiology, Bitter Culture

Even for sensory anthropologists, bitterness is a taste that "borders on the universal" (Sutton 2010: 216). Regarded as "the receptor system that guards the entry into the body," taste helps to avoid ingesting harmful or inedible substances and to consume what is nourishing (Rozin 1998: 28). Bitterness itself is particularly characterized by "rejection-withdrawal" and a "gape response;" a facial movement often observed in infants, where they open their mouths wide, and eject the objectionable material (*ibid.* 9). The ability to taste bitter substances is held across many species (cf. Muñoz *et al.* 2020 for a discussion of taste in blood sucking insects). Beyond the instinctive distaste response that protects against toxic substances, innate responses to bitterness give a limited sense of its complexity. As non-specialists, humans acquire knowledge about what to eat through cultural transmission and individual learning, allowing them to be flexible about what they eat, they have impressive systems that allow them to develop both tastes and aversions to different foods. Gustatory experience is shaped by a rich interplay of biology, culture and individual experience (Rozin 1998: 13; Howes 2003: 97; Sutton 2003: 225). Even on a physiological level, not all tastants that are toxic taste bitter and not all bitter tasting materials are toxic: when we taste bitterness it does not signal that we have come into contact with a specific material, thousands of "structurally diverse" molecules have a bitter taste (Korsmeyer 2002: 76; Kinnamon 2012: 1). However, the association between bitter taste and pharmacological activity is close enough that researchers now use machine learning to predict new drugs by exploring the chemical spaces of bitter tasting materials (Margulis *et al.* 2019). One of the goals of doing this is to identify promising molecules that are not so bitter tasting that patients will be unwilling to take them. Another is that the perceived bitterness of a substance also seems to correlate with how toxic it is to different bodily systems.

Different tastes are detected through taste receptor cells. While there are traditionally five tastes, bitter, sweet, salty, umami and sour, the detection of calcium, metallic tastes and oleogustus (fat) (Running *et al.* 2015) are more recent additions to what are officially considered to be distinct tastes. There are also a number of mechanical factors and chemoreceptors that contribute to the sense of an overall flavour; the hot pepper capsaicin spice and menthol from mint are both chemical senses. As proteins, bitter substances are detected through *T2R* cells, although "some bitterants are pharmacologically promiscuous," interacting with other receptors and metabolic systems (Bloxham *et al.* 2020: 56). Perhaps surprisingly, taste receptor cells are not only found in the mouth, tongue, and epiglottis. Emerging physiological research has identified them in many other bodily systems; gastrointestinal, respiratory, reproductive, urinary and cardiac. The functions of taste receptors in these systems are only partially understood (Di Pizio 2019: 57). In the gastrointestinal system the stimulation of chemo-receptors in the mouth and down into the gut releases a range of hormones, acids and enzymes essential to digesting food and to absorbing nutrients (McDonald 2010: 140). Researchers exploring the role of bitter detecting cells in the heart speculate as to their role, and even the source of the chemicals involved. The heart tissue may be responding to materials in food, toxins produced in the body by micro-organisms, or chemicals produced endogenously by the body itself (Bloxham *et al.* 2020).

Bitter Drugs

Despite the considerable medical properties of bitter compounds, the Western biomedical paradigm associates pharmaceutical taste with uncooperative patients reluctant to take bad tasting medicines (Menalla *et al.* 2013). When a discussion of how the sensory dimensions of medical treatment may influence its success, "placebo responses" are invoked, and attempts to harness these have mainly concentrated on visual design elements (a tablet's colour, packaging or marketing) rather than taste (de Craen *et al.* 1999; Moerman 2002). However, many medical traditions, including Traditional Chinese (Porter 1999: 153) and Tibetan Medicine (Gerke 2014), incorporate sophisticated approaches to taste as an element of their treatment practices. The correct balance of tastes in the diet can maintain the health of the body and food and medical knowledge and practices intersect. This model informs

the use of medical decoctions as well as culinary practices whereby "disharmonies can be corrected by adjusting the flavour of particular meals" (Ody 2000: 9). Here culinary and medical knowledge and practices intersect. At least as far back as the formative cuisines of the Chinese *Song* dynasty (960–1279) "good prescriptions" and "good recipes" have been in some ways interchangeable (Freeman 1979: 171). A correct balance of tastes in the diet can maintain the health of the body and "disharmonies can be corrected by adjusting the flavour of particular meals" (Ody 2000: 9). This same balance of taste qualities informs the use of medical decoctions and pharmacological classifications (Farquhar 2007: 294f). The five (or six) tastes—sweet, sour, bitter, salty and pungent/acrid—are connected with the elements, and a further two qualities, astringent and bland/neutral are also used (Ody 2008: 8). While they demonstrate a context in which taste is inseparable from the maintenance of bodily health, the sophistication of these medical systems in terms of their use of taste make bitterness as it is dealt with here seem a rather crude category. However, as Farquhar (2007) describes it, in Traditional Chinese herbal medicine's characteristic use of strong flavours, bitterness seems key;

> "[…] though patients often complain that herbal decoctions are 'too bitter' *(ku)*, […] a refined palate can no doubt also distinguish amidst the bitterness some tastes that are more sour, salty or pungent. Considering that individual drugs of diverse flavors are usually boiled together, it must be difficult to sort out all the tastes of a complex prescription. But there's no doubt, I think, that for a medicine to do anything very complicated it must assault the sufferer with a strong and complex flavor." (Farquhar 2007: 293)

This sensory "assault" is not only a matter of putting on a show for the patient. Chinese medical texts explain the functions of these medicines in terms of their flavour, a quality which is recognized as inherently and physiologically effective. Not separating the realm of "sensory input" from that of the known biological properties of the materia medica, raises a question; "what is the efficacy of a 'flavor'?" (*ibid.*) This question, of to what extent can a taste influence bodily healing, seems to be partly answered by recourse to the placebo response, that being aware of a treatment can increase the effects: "The rationally known efficacies of things cancel the relatively ephemeral experience of ingesting them, and our carnal tastes, when they are invoked, drift upward toward the cultural domain where subjective experience is stored." (*ibid.* 295) Bitter medicines then, seem to suggest that we might read through a lens that resists the relegation of sensory input to another realm. What might be the result if we resist the impulse to "drift upward" to a subjective domain, and instead like so many other medical systems, consider the "relatively ephemeral experience of ingesting" (*ibid.* 295) bitter tasting substances as inherently healing? Instead, let's dig down by broadening our contextual understanding of bitterness' relation to healing, tasting and chemical-ecological relations.

The Roots of Bitter Medicines in Chemical Ecology

In food and medicine, a sense of ambivalence about the meaning of bitter tastes is a result of the complex ecology of volatile chemicals that plants use to signal to one another and to communicate with and influence other species. In addition to the primary metabolites that function to control factors like growth in their own bodies, plants, fungi and bacteria produce compounds called secondary metabolites or *alleochemicals* which influence the growth, health or behavior of their own and other species (Johns 1990: 4f). Chemical co-evolution has produced many compelling inter-species interactions that the science of chemical ecology is still revealing in fascinating accounts of the chemical space within which highly complex inter-species communications take place. Hustak and Myers' (2012) curiosity about the extent to which these scientists are willing to ascribe agency to their objects of study leads them to suggest that;

> "[p]ullulating under the surface of chemical ecologists' neo-Darwinian accounts, we find the glimmerings of an affective ecology contoured by affinities and repulsions and teeming with articulate plants and other loquacious organisms" (*ibid.* 79).

A well-known and fairly straightforward example of plant-mammal communication would be the

fructose sugars in the fruit produced by the apple tree which attract animals to distribute their seeds. Indeed, the appeal of these fruit is so great that apples are even propagated by humans, who clone trees with desirable fruit and growth characteristics, spreading them worldwide (Pollan 2001). In distinction with its flesh, the apple seed is unpalatable, it contains a cyanogenic compound that when digested is metabolized into the poison cyanide. More impressive are examples of species using chemicals originally intended as deterrents for their own purposes. The milkweed butterflies, including the Monarch butterfly (*Danaus plexippus*), lay their eggs on milkweed plants (*Asclepias*). These plants produce cardenolides, steroidal toxins which affect the heart tissue of mammals. On hatching, the butterfly larvae eat the plant tissues and sequester toxic compounds produced by the plants into their own bodies, making themselves poisonous to predators (Johns 1990: 252). More impressive are examples of plant signaling predators of the caterpillars they detect feeding on them. Many chemicals have more than one function in their interactions with other species, which mean that it may be impossible to know which purpose they first evolved to serve (Rasugo *et al.* 2015).

Bitter compounds include a huge array of chemicals produced by plants; saponins, tannins, glycoalkaloids, cucurbitacins and alkaloids. Intended as they are to influence the physiology of other organisms, secondary metabolites offer a diverse array of pharmacologically active chemicals, with many potential medicinal uses; analgesics, psychoactives, emetics or antidotes for poisoning. Many bitter tasting chemicals have a defensive function and deterring those creatures that would engage in herbivory or protect against fungal and bacterial attack. It has been argued that here lie the first origins of human medicine;

> "in exploiting plant foods it is impossible to avoid their defensive chemicals [...] in adapting to them our species has made them an essential part of our internal ecology" (Johns 1990: xv).

As Johns explains it, the use of plant-derived toxins in human ecology is an inverted version of that used by the milkweed butterfly. Rather than poison larger animals that may eat us, it offers a way of dealing with predators that are smaller than us, with "parasitic micro-organisms and invertebrates that consume us from the inside out" (*ibid.* 252). The use of plants as medicine has its root in animal ancestry (Johns: 1990: xv). Since primatologists first observed chimpanzees eating carefully folded rough and toxic leaves to scour out intestinal parasites, many examples of *zoopharmacognosy*—the deliberate use of plants by animals for self-medication – have been recorded (Shurkin 2014: 17339ff).

Eating Bitterness

While bitter chemicals have become part of human internal ecology, they have also influenced technical and cultural practices. Processing techniques to remove toxins include heating, leeching, fermentation, grating, using lye, drying and mixing with clays (Johns 1990: 7). Domestication has resulted in plants that produce leaves and fruit that lack the toxic chemicals of their forebears. The *Cucurbitaceae* family, for example, which include pumpkins, squash, and cucumbers, produce toxic and very bitter tasting compounds called *cucurbitacins*. Selective breeding has made them more palatable, but less pest- and frost-resistant. Bitterness is not always an undesirable property. Herbs cultivated or gathered for their medical properties retain the bitter tastes associated with their pharmacological properties. Many other bitter plants inhabit the peripheries of agriculture. Semi domesticated plants, weeds and other seldom-used famine foods offer a stand-by for leaner times and hungry gaps, for example the seeds of bitter *hanza* berries that are eaten in Niger when drought destroys other crops (Kelley 201: 123).

The act of intentionally consuming bitter foods takes on symbolic resonance in a number of cultures. As Sutton (2010) points out; "[T]he metaphorical uses of this flavor are instantly recognisable: Ingesting bitter food as a representative of bitter experience can be found in many societies and rituals" (*ibid.* 169). He cites the *Passover* ceremony, which references Egyptian persecution through the consumption of bitter herbs, which map onto the bitter experience of persecution. The title of Johns' (1990) book on chemical ecology and human medicine *With Bitter Herbs They Shall Eat It* makes the same reference; its title a quotation from the *Hagadah*. There are other ex-

amples; in modern Chinese, the common term for suffering—*chiku*—translates as "eating bitterness," and often references the swallowing of difficulties (Farquhar 2007: 292). During the Cultural Revolution (1966–69) Chinese authorities encouraged people to eat a "recall bitterness meal" which combined wild vegetables and rice chaff in an unappetizing gruel, and was to be eaten while concentrating on memories of the bitterness of the society of the preliberation era (Oxfeld 2017: 79).

In their practical necessity for sustenance, knowledge of growing, preparing, serving, tasting and eating seem to offer more than metaphors, particularly given the danger and immanence of eating. Particularly when cooking and eating are social transactions, as is often the case, offending a palate, or worse, poisoning a guest with carelessly or ineptly prepared food is a legitimate concern. It is perhaps here that interspecies relations become particularly mixed up in interpersonal and intercommunal ones. Amy MacLachlan's (2011: 12) ethnography of the *Uitoto* diaspora in the borderlands of the Colombian Amazon offers an example for the immanence of taste knowledge. In *Uitoto* culture sweetness and bitterness feature heavily in daily emotional and practical life as mixed gustatory and affective experiences. A particular plant, bitter manioc (*Manihot esculenta*), is at the heart of this. Also known as *cassava* or *yuca*, manioc is a perennial plant native to the Amazon but extensively cultivated worldwide in both tropical and subtropical regions. Drought-resistant and able to grow on poor soil, in 2013 it was estimated to provide food to over 800 million people worldwide (Food and Agriculture Organisation of the United Nations 2013). The plant is cultivated in two main types, sweet, and bitter; both require processing before they are safe to consume. This is because the high starch tubers contain substances called *cyanogenic glycosides* that are turned into *hydrogen cyanide* when the plant is damaged.

Bitter manioc tubers are the basis of a wide variety of *Uitoto* recipes in daily and ritual use. MacLachlan (2011) shows that through the processing of manioc, sweetness and bitterness are embedded within *Uitoto* culture as technical culinary practices that shape how well-functioning relationships are understood. Preparing manioc by removing the toxins from the tubers is a multi-day process that is technically complex and physically exhausting. A lack of expertise and poor execution can result in the literal "poisoning" of relationships. "Bitter manioc is made 'sweet' by the expert labour of adult women, a capacity that is indexical of their status as well-made and knowing women" (*ibid.* 12). MacLachlan's hosts, while training her in manioc preparation would recount "nightmarish" cautionary tales whenever they observed her skills lacking. In one story, a young wife labors for days on a generous feast only to accidentally poison her husband's family. MacLachlan's observations of manioc preparation suggest that that the practices hold an affective resonance in a context in which there are substantial intercommunity and interpersonal conflicts. She describes a continuity in what is described as "sweetening" between culinary and social practices;

> "Uitoto women's skilled forgetting of memories and emotions they described as 'bitter' often appeared as the affective equivalent of leaching manioc, a deliberate rendering of the socially poisonous and debilitating into sweetened continuities in relations" (*ibid.* 170).

Sometimes acts of processing and consuming foodstuffs is accompanied by more direct references to healing. When the *Pomo* people of Northern California make acorn mush they describe "healing medicine" as well as an imperative to remember. For the *Pomo*, as in the recall bitterness meal, there is a connection to a violent history that must be preserved which, like bad tasting medicine, must be passed down to the children for their own good;

> "The old women whose words animate this recipe and its meaning argue over how bitter it must be, but they all call it medicine. They laugh at the children who want it sweeter, who do not understand the balance that Pomo people expect and value between sweet and bitter, comfort and pain, bounty and deprivation. The oldest leach the acorns of just enough tannin to avoid stomachaches, leaving enough 'toxin' to heal them of the legacy of settler violence. Bitter medicine heals in a bitter time." (Noel 2014: 155f)

The balancing act of "just enough" toxin to heal seems to go together with a recognition of the need for first-hand engagement with the experience of bitter taste. In contemporary herbal medicine the

digestive stimulation caused by bitter tasting compounds is considered to have a psychological effect of releasing individuals from negative emotions; "they help one let go of stuck energy – particularly anger and frustration – emotions often viewed in traditional medicine as being tied to stagnant/sluggish liver energy. Bitters, in addition to releasing bile, also help people let go of the emotional energies housed in different organs" (McDonald 2010: 147). Contemporary North-American herbalists have raised the idea of a "bitter deficiency syndrome" (McDonald 2010: 147) where Western-urbanized diets lacking in bitter tastes fail to stimulate the digestive system leading to sluggish energies and emotional problems. In cultures that retain diets that include a sizable proportion of leaf-based materia—a likely characteristic of ancestral human diets—there remains a lack of demarcation between the role of leaves understood as nourishing food and an awareness of their medicinal properties (Johns 1990). A reduction of the consumption of bitter leaves may have been influenced by shift from rural to urban living has reduced opportunities for people to forage wild growing leaves to use as salad or "pot herbs" and access to a smaller selection of less bitter commercially-grown leaves. While they argue that contemporary palates have a narrowed vocabulary of flavour provided by plant chemicals, bitterness is still prevalent in many forms. Beverages such as coffee and wine and foods like chocolate take their enjoyably bitter tastes from leaf *tannins*, a key flavour in leaf-based teas as well as many of spices. Bitter herbs are still connected to digestion and herbal "bitters"—originally alcohol-based tinctures combining bitter herbs such as yarrow, wormwood, and orange—have a history dating back to Hippocratic medicine and are still sold as a health supplement, although more often encountered in aperitifs, digestifs or mixed drinks that accompany a meal. Perhaps bitter herbs remain in plain sight.

The complexity of a herb

Using plants for healing is made complex by the way in which plants produce secondary metabolites. These are not single, simple compounds as they would be encountered in pharmaceutical chemistry. They are synthesized with other sometimes complimentary chemicals which are consumed together when consuming whole plant materials. They have their own interactions, as well as interactions with the systems of the body. Countless pharmaceutical medicines have been synthesized as copies of the active chemicals found in plants, resulting in the availability of pure substances with known strengths. However, Kaptchuk and Croucher (1986: 53) have argued that despite the apparent advantages of pure chemicals, isolating them fundamentally changes how they work;

> "the biochemical effect of a plant depends on the totality of the organic and inorganic substances in it. The same active ingredient within a plant has remarkably different effects when it is isolated from the plant" (*ibid.* 53).

For example, Chinese angelica (*Angelica sinensis*) effects the uterus in varying ways depending on its initial state, relaxing a tight uterus and contracting a loose one. Rather than being unpredictable, these effects stem from the regulation of bodily systems. As they argue, isolating substances risks a loss of knowledge: focusing on the known chemical qualities of a healing material rather than trying to understand the complex properties of a complete living being can lead to useful effects being overlooked.

In order to engage this complexity, they argue, those practicing in many traditions that use herbal medicine must recognize a feeling for each plants' character which has a

> "soul with its own texture and pulse, a way of interacting with other herbs and indeed with bodily sensations and feelings not measurable in the biochemist's lenses and scales. […] the feeling for their mixture, balance and synergetic effects constitutes the art of herbalist medicine" (*ibid.* 56).

A direct sensorial and synesthetic engagement with the plants that they use is required of practitioners of herbal medicine to discern their properties and proper use (cf. Gerke 2014: 27 for discussion of touch and taste as key in Tibetan medical practice). In an essay about the healing properties of bitterness, Jim McDonald (2010) describes how sensory observation of "scent," "color" and "flavour" informs the herbalists' awareness of plants' virtues: "Only by embracing bitterness can we learn what it has to offer—to teach us. In

this embrace we find it rich in medicine" (*ibid.* 152f). As he asks: "If plants' tongues speak to our tongues, then what do we not hear when we taste no bitterness?" (*ibid.* 141). In thinking about what this means for healing, we might ask then what is excluded from medicine in the move to pharmacy; if a relationship with plants originally medical tastes, what does it mean to encounter them out of their original context? To what extent do the aesthetics of the chemical senses inflect the meaning of medicine; could there be a *bitter deficiency syndrome* in the clinic?

The Bitter End

From chemical tastes registered in the inner tissues of the body's systems to the messages passed between organisms, bitterness has many resonances. It manifests in affect, taste, internal chemistry and external ecology. Rather than try to disentangle these different aspects, this article has drawn together evidence that suggests how bitter affects and bitter chemicals are connected. Taking literally the metaphorical connections between affect and taste and attending to connections between personal, affective embitterment and the actual consumption of bitter tasting compounds allows us to explore the ways in which *taste matters*. Framing the connection as homology rather than analogy offers taste and feeling as embodied engagements with human and more-than-human ecologies. That there are commonly held cultural traditions associated with emotional bitterness and healing is unsurprising given the chemical associations between bitter tasting materials and pharmacological action. Sharing the bitter experience needed to make use of bitter materials invites reminders of know-how, technical skill and experience, knowledge used in the complex negotiations of plant healing and the sweetening of interpersonal and interspecies relations. Riskily gained bitter experience holds resonance for remembering what can and has been weathered, it reminds us of what to do when tough times come around again. It offers a reminder that when we taste bitterness, it is because sometimes, plants tongues speak to our tongues.

References

Bitter Liebe 2020. *About Bitters*. https://bitterliebe.co.uk/pages/about-bitters. [2020-06-04].

Bloxham, Conor J., Simon R. Foster & Walter G. Thomas 2020. A bitter taste in your heart. *Frontiers in Physiology* 11: 431.

Bosivert, Raymond D. & Lisa Heldke 2016. *Philosophers at table: on food and being human.* London: Reaktion.

Carolan, Michael 2012. *Embodied food politics*. Farnham: Ashgate.

Eitan, Margulis, Ayana Dagan-Wiener, Robert S. Ives, Sara Jaffari, Karsten Siems & Masha Y. Niv 2019. Intense bitterness of molecules: machine learning for expediting drug discovery. *Computational & Structural Biotechnology Journal* 19: 568–576.

Freeman, Michael 1979 (1977). Sung. In K. C. Chang (ed) *Food in Chinese culture: anthropological and historical perspectives.* New Haven: Yale University Press.

Cheng, Fang & Zhihui Cheng 2015. Research progress on the use of plant allelopathy in agriculture and the physiological and ecological mechanisms of allelopathy. *Frontiers in Plant Science* 6: 1020.

Di Pizio, Antonella *et al.* 2019. Bitter and sweet tasting molecules: it's complicated. *Neuroscience Letters* 700: 56–63.

Farquhar, Judith 2002. *Appetites: food and seys in postsocialist China*. Durham: Duke University Press.

––––– 2007. Medicinal meals. In Margaret Lock & Judith Farquhar, Judith (ed) *Beyond the body proper: reading the anthropology of material life.* Durham: Duke University Press. 286–296.

Food and Agriculture Organisation of the United Nations 2013. *Save and grow: a guide to sustainable production intensification*. http://www.fao.org/3/a-i3278e.pdf/ [2020-06-12].

Gerke, Barbara 2014. The art of Tibetan medical practice. In Teresia Hofer (ed) *Bodies in balance: the art of Tibetan medicine.* New York: Rubin Museum of Art.

Highmore, Ben 2010. Bitter after taste: affect, food, and social aesthetics. In Melissa Gregg & Gregory J. Seigworth (eds) *The affect theory reader*. Durham: Duke University Press.

Howes, David 2003. *Sensual relations: engaging the senses in culture and social theory.* Ann Arbor: University of Michigan Press.

Hustak, Carla & Natasha Myers 2012. Involutionary momentum: affective ecologies and the sciences of plant/insect encounters. *Differences* 23, 3: 74–118.

Johns, Timothy 1990. *With bitter herbs they shall eat it: chemical ecology and the origins of human diet and medicine*. Tucson: University of Arizona Press.

Kaptchuck, Ted & Michael Croucher 1986. *The healing arts: a journey through the faces of medicine.* London: British Broadcasting Corporation.

Kelley, Lindsay 2014. Plumpiñon. In Eben Kirksey (ed) *The multispecies salon.* Durham: Duke University Press. 123–134.

Kinnamon, Sue C. 2012. Taste receptor signalling: from tongues to lungs. *Acta Physiologica* 204, 2: 158–168.

Kirksey, S. Eben, & Stefan Helmreich 2010. The emergence of multispecies ethnography. *Cultural Anthropology* 25, 4: 545–576.
Korsmeyer, Carolyn 1999. *Making sense of taste: food and philosophy*. New York: Ithaca.
McDonald, Jim 2010. Blessed bitters. In *Llewellyn's Herbal Almanack*. Woodbury: Llewellyn.
McLachlan, Amy L. 2011. Bittersweet: the moral economy of taste and intimacy in an Amazonian society. *Senses and Society* 6, 2: 156–176.
Mennella, Julie A.; Spector, Alan C.; Reed, Danielle R. & Coldwell, Susan E. 2013. The bad taste of medicines: overview of basic research on bitter taste. *Clinical Therapy* 35, 8: 1225–1246.
Muñoz, Ignacio J.; Pablo E. Schilman & Romina B. Barrozo 2020. Impact of alkaloids in food consumption, metabolism and survival in a blood-sucking insect. *Scientific Reports* 10: 9443.
Myers, Natasha 2015. Conversations on plant sensing: notes from the field. *Nature Culture* 3: 35–66.
Noel, Linda *et al.* 2014. Bitter medicine is stronger. In Eben Kirksey (ed) *The multispecies salon.* Durham: Duke University Press.
Ogden, Laura A., Billy Hall & Kimiko Tanita 2013. Animals, plants, people, and things: a review of multispecies ethnography. *Environment and Society* 4: 5–24.
Oxfeld, Ellen 2017. *Bitter and sweet food, meaning, and modernity in rural China*. Oakland: University of California Press.
Paxton, Heather 2008. Post-Pasteurian cultures, *Cultural Anthropology* 23, 1: 15–47.
Petitmengin, Claire 2007. Towards the source of thoughts: the gestural and transmodal dimension of lived experience. *Journal of Consciousness Studies* 14, 3: 54–82.
Pink, Sarah 2006. The future of visual anthropology: engaging the senses. London: Routledge.
Pollan, Michael 2001. *The botany of desire: a plant's-eye view of the world*. New York: Random House.
Porcello, Thomas *et al.* 2010. The reorganization of the sensory world. *Annual Review of Anthropology* 39: 51–66.
Porter, Roy 1999. *The greatest benefit to mankind: a medical history of humanity from antiquity to the present.* London: Fontana.
Reed, Edward S. 1997. *Encountering the world: toward an ecological psychology*. Oxford: University Press.
Rozin, Paul 1990. Getting to like the burn of chili pepper. In Barry G. Green *et al.* (eds) *Chemical senses. Volume 2: Irritation.* New York: Dekker.
––––– 1998. *Towards a psychology of food choice*. Bruxelles: Danone.
Running, Cordelia A., Craig A. Bruce, & Richard D. Mattes. 2015. Oleogustus: the unique taste of fat. *Chemical Senses* 40: 507–516.
Seremetakis, Nadia 2017. *An introduction to cultural anthropology*. Cambridge: Scholars.
Shurkin, Joel 2014. Animals that self-medicate: many animal species have created their own pharmacies from ingredients that commonly occur in nature. *Proceedings of the National Academy of Sciences of the United States of America* 111, 49: 17339–17341.
Stoller, Paul 1989. *The taste of ethnographic things: the senses in anthropology*. Philadelphia: University of Pennsylvania Press.
Sutton, David 2010. Food and the senses. *Annual Review of Anthropology* 39: 209–223.

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