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IN RELATION TO MICROBES

GUEST EDITORS

VALDIMAR TR. HAFSTEIN, ÁKI GUÐNI KARLSSON & VEERA KINNUNEN

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Guest Editors
Valdimar Tr. Hafstein, Áki Guðni Karlsson & Veera Kinnunen

Table of Contents

Articles

Valdimar Tr. Hafstein, Áki Guðni Karlsson & Veera Kinnunen
In Relation to Microbes: Fermenting Cultures from Food to Soil.....1

Helga Ögmundardóttir & Eysteinn Ari Bragason
Compostories: Exploring Narratives of More-than-Human Relations in Soil Communities.....17

Maria Giovanna Cassa
Setting the Table for Relatedness: Fermentation in Designing Permaculture Projects in Sardinia.....37

Veera Kinnunen
Speaking with Microbes: Smell as Transspecial Correspondence.....61

Ragnheiður Maísól Sturludóttir & Jón Þór Pétursson
In the Company of Bread: Sourdough Baking as Symbiotic Care.....76

Lindsey Foltz
Microbial Entanglements in the Bulgarian Cellar: Control, Collaboration, and Quiet Food Sovereignty.....96

Áki Guðni Karlsson, Bryndís Eva Birgisdóttir & Jón Þór Pétursson
Fermented Living: Challenges in Adopting a Fermented Dietary Regime and the Role of Food Memories in Acquiring New Tastes.....117

Responses

Salla Sariola
Microbiosocial: What if the Holobiont was the Starting Point, not the Endpoint?.....136

Amber Benezra
Multiple, Messy, Microbial.....138

Bernard Tschofen
Fermenting Cultures.....142

Daniel Münster
Fermentation and More-than-Human Health: How to Speak of/to Soils and Other Aliens?.....145

In Relation to Microbes: Fermenting Cultures from Food to Soil

Valdimar Tr. Hafstein
University of Iceland
Iceland

Áki Guðni Karlsson
University of Iceland
Iceland

Veera Kinnunen
University of Oulu
Finland

Fermentation as Vernacular Microbiology

The sun shines brightly in the cool Icelandic spring weather as a middle-aged man wearing a baseball cap and sunglasses pours thick, milky liquid through a clean cloth into a glass bowl. His audience follows the performance in focused silence. We are at the Erpsstaðir Creamery in western Iceland. It is our first stop in a series of workshops, in which we are going to discuss living cultures of living cultures, that is, vernacular practices of working with microbes. Our host, dairy master Þorgrímur Einar Guðbjartsson, is demonstrating how skyr, an Icelandic fermented dairy product, was traditionally made.

Skyr is a good example of the ongoing renaissance of microbial cultures, the phenomena that our small multidisciplinary group has set out to investigate. As part of the ongoing social success of the gut microbiome, the rich biocultural heritage of fermented foods, such as skyr, has been rebranded and successfully commercialized as healthy food, using terms like "probiotic." Although the microbial cultures of food products produced at industrial scale are generally far more homogenous than the "wild" cultures, produced on a small scale on the farm, in the home, or by craftspeople, imaginaries of unique and ancient microbial cultures run rampant in the narratives created around them (Pétursson and Hafstein 2022). References to "heirloom microbes," sometimes trademarked or patented, form part of marketing strategies that may be referred to as heritage branding (Hafstein, Pétursson and Marteinsson 2024).

Indeed, the history of Icelandic skyr pre-dates the comparatively recent scientific discovery of microbes by a millennium, at least. According to one origin story that Þorgrímur tells, the skyr cultures arrived in Iceland in the armpits of the first settlers over a thousand years ago. For centuries, protein-rich skyr was a side-product of but-

Cultural Analysis 22.2 (2024): 1–16

ter-making and provided an important source of nutrition in the Icelandic countryside, where the more valuable butter was produced for trade. Our human digestion has always benefited from the labor of microbes; not only those working in our own gut, but also from diverse ways of preparing and preserving food by fermentation: curing, souring, and pickling (Hendy et al. 2021). As fermentation activist Sandor Katz puts it, fermentation allows the food to be pre-digested before it enters the mouth (Katz 2012, 30).

The term "fermentation" refers to slightly different things in different contexts, but it may be defined simply as a microbial metabolism that converts carbon compounds to energy anaerobically (Hendy et al. 2022, S198). Fermentation processes take place in cells naturally, but they have also been utilized intentionally in food preservation and preparation by human cultures since prehistoric times. Dunn et al. (2020) hypothesize that already hominins have very likely used fermentation in processing food, and even other-than-human carnivores are known to preserve meat by taking advantage of its fermenting qualities (see Dunn et al. 2020; Speth 2017). Adopting fermentation practices also affected lived environments: as fermentation practices were typically carried out with the help of bodily microbes, humans began to spread their genomes across environments. For instance, the *Lactobacillus* species used in sourdough breads are body-related (Gänzle and Ripari, 2016) and *Streptococcus thermophilus* used to ferment skyr and yoghurt is an ancestrally mouth-associated bacteria species (Goh et al. 2011). Circulating certain bacterial strains in food intensified their presence in the lived environment, resulting in "extended guts," which allowed digestion to happen where food was fermented (Dunn et al. 2020, 9). Therefore, it is not far-fetched to see fermented foods as an extension of the human body and its abilities, as part of a social microbiome (Sarkar et al. 2020), or a "communal gut."

With emphasis on the biocultural and ecological effects of fermentation, it may be understood more broadly as a collaboration between species and kinds, a process where "microbes, animals and people thrive, where biodiversity becomes more than a gathering of species," in the words of Mutlu Sirakova: "a web of relations and interactions that holds its own stories" (2023, 251). This formulation sheds light on how, together, humans and other-than-humans transform and create their conditions of living and even their own biological make up (see Lock and Nguyen 2018, 335). Thinking with fermentation provides tools to reimagine humans as "ensembles of biosocial relations" (Pálsson 2013a, 24) and to cross the nature-culture divide that has been an organizing principle of Western knowledge for a long time (see e.g. Theriault 2017; Thompson 2019; Ingold 2000).

Microbial Ontologies

Over the last two decades, we have come to realize that nature is infinitely more diverse than we had previously imagined. Facilitated by new DNA sequencing technologies that vastly extend our perception of such diversity, this realization is contemporaneous with a challenge posed within the humanities and social sciences to an anthropocentric narrowing of the scientific imagination. Taken together, the discovery

of microbial multitudes and the recent posthuman turn offer every reason to reconsider foundational notions and concerns of fields of knowledge such as social sciences and humanities.

Recent advances in metagenomics (the study of genetic material directly from environmental samples) leave no doubt that microbes are the dominant life form on the planet. Microbes are everywhere: in the depths of the ocean and up in the clouds, in the polar ice sheets, as well as geysers and hot springs; also in our kitchens and gardens, milk and vegetables, our skins and genitals, our mouths and guts. Microbes are a generic term for a plethora of diverse micro-organisms ranging from bacteria to archea and fungi. They have been around for 3.5 billion years, the first form of life on Earth and always by far the most widespread, dominating the planet in quantity, and altering the chemistry of the earth so that other life forms may exist and evolve. Animal life—including that of human animals—has never been separate from microbial life (see e.g., Margulis and Sagan 2002). Indeed, it turns out that human cultures are inextricable from microbial cultures. Such studies reveal a dizzying variety of microbial organisms that make up the microbiome of animals, plants, and soils, and they have profoundly shaken even our most basic understanding of what it is to be human (Rees et al. 2018). The realization of just how crucial and vital the microbial multitude is forms the premise of the so-called "microbial turn" that heralds the emergence of new posthuman or more-than-human perspectives in the social sciences (Paxson and Helmreich, 2014; see also Brives and Zimmer 2021).

The term posthumanism has been used to group together theories and approaches that seek to decenter humans by accounting for the meaning-making and agency of other life forms during the Anthropocene epoch (Elton 2019). For the past two decades, posthumanist theories have been developed in various disciplines such as food studies (Elton 2019), feminist philosophy (Braidotti 2018), public health (Rock et al. 2014; Hinchliffe et al. 2017; Sariola et al. 2020), folklore (Thompson 2019), geography (Whatmore 2002), feminist environmental studies (Hamilton and Neimanis 2018) and indigenous studies (Liboiron 2021). Diverse approaches, such as nonrepresentational theory, new materialism, and multispecies ethnography all engage with the ontological, epistemological, and methodological possibilities of exploring intimate connections between different life forms (e.g. Elton 2019; Kirksey and Helmreich, 2010; Ogden et al., 2013; Wolf, 2015; Hey 2017). These approaches build on theoretical groundwork by scholars such as Barad (2003), Braidotti (2017), Haraway (2008), Latour (1993), and Deleuze and Guattari (2004). What pulls these different posthumanist strands together is the rejection of the dominant Western worldview that constructs nature as separate from humans.

Guided by posthumanist thought (Haraway 2008, 2016), symbiogenetic evolutionary theories (Margulis 2002), and new microbial research, we have learned to understand the human organism as a "composite of many species" (Paxson 2008, 38–39). The numbers vary a bit, but by all accounts, "we" are outnumbered: less than half of our bodies' cells are human (ca. 1:1.3), the majority consisting of a multitude of microbial species with whom we co-exist in the most intimate way imaginable, co-consuming and co-producing (Sender, Fuchs and Milo 2016a, 2016b). Human bodies

are increasingly understood as holobionts or supraorganisms comprising bacteria, archaea, eukaryotes, and viruses with whom we have coevolved (Morar and Bohannan 2019; Gilbert et al. 2012; Sariola and Gilbert 2020). Gilbert and Sapp crystallize the emerging symbiotic ethos poetically by proposing that "we have never been individuals," but instead, "we are all lichen," referring to symbiotic life-forms comprised of fungi and cyanobacteria (2012, 336). Or, as Pálsson puts it: "If humans are assemblies of aggregates of life forms, the outcomes of ensembles of biosocial relations, then they have not simply co-evolved with more-than-human microbes; humans are microbes, in a literal sense" (2013b, 241).

Within a posthumanist framework, more-than-humans have agency that can put things in motion, trigger effects, and influence outcomes. However, Sayes has noted that "nonhumans do not have agency by *themselves*, if only because they are never by themselves" (Sayes 2014, 144). Agency between humans and nonhumans should thus more accurately be defined as relational and "spun" between social actors (Whatmore 2002, 4). In this multispecies world, human existence therefore unfolds in relationships that connect us to microbes (Heldke 2018; Paxson 2008; 2016; Brives, Rest and Sariola 2021), mushrooms (Tsing 2012; Felder et al. 2012), bees (Moore and Kosut, 2014), and dogs (Haraway 2008; Mechling 1989). These relationships illustrate everything from kinship relations and relationships of dependence, as well as struggles and relationships of antagonism (Haraway 2008; Yong 2016; Elton 2019). Taken together they demonstrate the constant power dynamics that take place every day in which humans do not always emerge as winners (Paxson et al. 2014; Lorimer 2016; Standley and Bogich 2013; Gröndal 2019). This relational understanding of the agency of humans and more-than-humans raises questions about how people and other life forms such as microbes mutually shape life and death on a day-to-day basis.

Studying Cultures of Cultures

Although metagenomic research can still be said to be at its inception, it is already changing how people imagine health, disease, and the relationship between humans and their environment (Lederberg 2004; Brives et al. 2015; Du Plessis 2017; Maroney 2018; Voelkner 2019; Broom, et al. 2019; Cañada 2019; Doron et al., 2019). As a result of increasing understanding of the vitality and ubiquity of microbial life, a paradigm shift is underway: rather than seeing microbes as inherently bad (pathogenic) or good (beneficial), a growing body of research has moved on from a narrow focus on germ theory—that certain diseases are caused by the invasion of the discrete body by foreign microorganisms—to a broader ecological understanding of human-microbial relationships, incorporating socioeconomic, cultural, spatial, and political contexts (Benezra 2023; Benezra et al. 2012; Ironstone 2019; Lorimer 2020; Paxson 2019, 2014, 2008; Sarmiento 2020; Tracy et al. 2018). The "microbial turn" thus brings forward new questions and challenges to scientific research (Benezra 2023; Greenhough et al. 2020; Heldke 2018; Paxson 2008, 2014; Fishel 2017).

Technoscientific innovation and policy agendas in connection with the human microbiome call for increased participation of social scientists in this emerging field (Stil-

goe et al., 2013; "Time for the social sciences," 2015). Social and natural scientists are encouraged to join hands and facilitate new and better understandings of how human and microbial worlds intersect (Benezra et al., 2012). Scholars within the social sciences and the humanities have heeded this call, shifting their attention to how microbes and humans live as "companion species" (Haraway, 2003; Beck, 2019), and how "human health, disease resistance, development and evolution have depended and continue to depend on interactions with microbes" (O'Malley and Dupré 2007, 158).

In his influential book from 1988, *The Pasteurization of France*, Bruno Latour (1993) describes the scientific "discovery" of microbes in the 19th century, and how new antimicrobial practices of food processing and hygiene became synonymous with microbiologist Louis Pasteur. Armed with discoveries in bacteriology, his disciples, the "Pasteurists" sought to transform human society, foodways, urban environments, health, and sexuality by controlling the spread of invisible threats to healthy life—the microbes. In so doing, they cemented the cultural imaginary of microbes as synonymous with disease, decay, and death for over a century. Coined by Heather Paxson (2008, 2014), the term "microbiopolitics" captures how human and microbial cultures are controlled and shaped by politics, social practices, biology, and landscapes. In the wake of the microbial turn in early the 2000s, Paxson identifies a movement that has sought to break free from the hegemonic Pasteurian microbiopolitical regime. With a nod to Latour, Paxson calls this movement Post-Pasteurianism. In the Post-Pasteurian imagination, human life is "symbiotic, multiple, mutualist, and in community with a nonself on which it depends" (Ironstone 2019, 336). Building on Paxson, Penelope Ironstone (2019) suggests the term "affirmative microbiopolitics" to challenge us to consider human-microbe relations outside the dominant immunitarian model that defines all microbes as intruding others to be eradicated. Instead, it becomes vital to theorize the human microbiome as a generative multitude, something that will enable us to change our thoughts and our practices, as well as to re-imagine who we are. As pointed out by Alexander Kriss (2013), the human microbiome "fundamentally threatens dominant Western conceptions of the self. We are not autonomous beings but a colony of diverse life, a human microbial collective." This is reflected in recent scientific papers that refer to humans as only one of a multitude of ecological creatures, along with the full spectrum of the life universe/biomasses (Wahlqvist 2016).

Empirical studies dealing with various microbiopolitics have explored new ways of thinking about companionship and hospitality – through "gut buddies" to tackle autoimmune disease as more-than-human achievements (Lorimer 2016), relating with the soil in the Anthropocene (Abrahamsson et al. 2014; Meulemans 2017, 2020; Krzywoszynska 2019, 2020; Krzywoszynska et al. 2020), and the microbiopolitics of colonial science in ancestral microbiome research (Maroney, 2017; Benezra, 2020). Geographer Jamie Lorimer refers to such practices as "going probiotic," to seek out alternatives to the "antibiotic model" of the 20th century in fields ranging from diet, health, and hygiene to environmental and planetary management. He proposes that probiotic practices are "working with rather than against ecological dynamics" to create "future visions for life on an increasingly unruly planet" (Lorimer 2019, 100).

Crafting Food, Soil, Sense and Sociality

The guests gathered to witness Guðbjartsson's skyr-making performance at the Erpsstaðir Creamery are a group of academics from fields of folklore and ethnology, anthropology, sociology, nutrition sciences, molecular sciences, microbiology, and environmental sciences. Together, we have set out to study the emergence of microbial practices such as skyr-making or sourdough baking, which have for long been marginalized and are now being rediscovered in a new context (see e.g. Lorimer 2020; Paxson 2008). We are interested in the imaginaries and narratives that come to play when microbial relations are forged anew. We all share a belief that to understand a complex phenomenon, such as relating to microbes in everyday life, scholars must leave the safety of disciplinary silos and collaborate, as difficult as it may be. Our aim is to examine vernacular fermentation practices from food to soil, hoping to provide new understandings and perspectives on microbial relations in everyday life.

In what follows, we take seriously the theoretical and methodological challenge that the microbial turn poses to cultural analysis, rising to it with the tools of ethnography, from participant observation to in-depth interviews to qualitative questionnaires, in dialogue with research in biological and nutrition sciences. This special issue of *Cultural Analysis* presents six ethnographic articles that each in its own way addresses the symbiotic living of humans and microbes and seeks to unveil how that coexistence is shaped through cultural practices. Each of the six empirical studies analyzes how human-microbial relations are cultivated, challenged, talked about, and imagined in everyday life. The authors are folklorists, ethnologists, sociologists, anthropologists, and nutrition scientists and their topics range from soil to food, from farming and baking to eating and composting, and from gardens to kitchens. Taken together, the articles bring into relief varied and conflicting social practices involved in human-microbial relations, including the circulation of microbial matter, narratives, and epistemologies within and between the communities that these engender (cf. Jasarevic, 2015; Hey et al., 2018; Houf, 2019; Spackman, 2018; Yarbrough et al., 2020). Indeed, fermentation of food and compost may be seen as a form of interspecies communication (Hey 2019), mediated by scent, sound, taste, touch, sight and thermoception, and complemented by stories, anecdotes, jokes, memes, and narrative bits and pieces that convey a shared sense of belonging. The research focuses on the generative power of such relations: making food, health, soil, sense, and sociality.

Some of the authors represented in this issue have collaborated for several years in an interdisciplinary research project based at the University of Iceland, called "Symbiosis: Human-Microbial Relations in Everyday Life," studying the effects and affects of these relations, as well as their social imaginaries, and how microbial matter and its transmission help to generate practices, consciousness, life-worlds, imaginaries, narratives, gut feelings, and social bonds. Others have come together in Nordic workshops under the banner "Craftlife: Crafting Food, Soil, Sense and Sociality" or in conference panels on related topics at meetings of SIEF (International Society for Ethnology and Folklore), AFS (American Folklore Society), and the Nordic Ethnology and Folklore Conference.

This special issue presents some of the outcomes of our collaboration. The focus of attention is on "metabolic everyday practices" such as making sourdough, preparing, and eating fermented foods, and waste management and composting. These practices are of course thoroughly entangled and often affect each other. As Amber Benezra notes, when the focus is on microbial relations, bodies and environments cannot be separated from each other (Benezra 2023). Not only do bodies impact environments and vice versa. Bodies, too, *are* environments.

The collection of essays in this issue provides glimpses into a variety of traditional and emerging microbial practices ranging from agriculture to culinary experimentations, and from age-old foodways to novel and not-so-novel methods of waste care. Our attention is on the ways in which people seek to maintain or to re-establish more affirmative (Ironstone 2019), "probiotic" relations (Lorimer 2020) with their microbial "messmates" (Haraway 2016). We do not wish, however, to suggest that microbial practices could—or should—enable establishing a neat chain of value-creation from food to waste, or a circle of eternal redemption. Microbial relations are more uncertain than that. This is also the reason we resist the temptation of organizing the articles hierarchically from food to waste; instead, we gather them around sites of engagement: the kitchen and the garden.

…in the Garden

In their article "Compostories," Helga Ögmundardóttir and Eysteinn Ari Bragason analyze responses to qualitative questionnaires about composting collected in collaboration with the ethnological archives of the National Museum of Iceland. They set out to examine how people who compost in Iceland talk about, perceive, and relate to their composts. As their analysis highlights, the motivations that drive composting practices range from the purely practical (the need to handle organic waste efficiently) to the spiritual (seeking deeper connection with nature). Regardless of their driving motivation, many respondents recount stories about forging a stronger connection and commitment to earth and living beings, including earthworms, insects, animals, and birds, through their composting practice. The most widely shared "compostory" relates to the morally elevating power of composting. The connection between compost and morals has also been noted by environmental author Michael Pollan, who writes that there is a certain "halo of righteousness" that has come to hover over compost and those who make it. However, to the surprise of the authors, the topic of "microbes" rarely came up except in response to questions that specifically raise it. Even then, the responses are sometimes perplexed: "I try to answer this seriously even though the questions are getting stranger and stranger" (Ögmundardóttir and Bragason, this issue). This may serve to remind us that humans have for millennia collaborated successfully with the diverse, invisible life forms now rather clumsily grouped under the generic term "microbes" (from the Greek "mikros" and "bios," literally small life) (Dunn et al. 2021). Only the scientific concept is a latecomer; coined in 1878, its popularization in the ongoing "microbiomania" (Helmreich, Roosth and Friedner 2025) is only a product of the last decade. Moreover, the results reveal that

despite all the commercial and scientific hype, the microbial or "probiotic" (Lorimer, 2020) turn is probably still relatively restricted, even marginal; not a dominant ontology steering national policies and urban planning, nor yet affecting most people's routines and life choices.

Maria Giovanna Cassa's article, "Setting the Table for Relatedness: Fermentation in Designing Permaculture Projects in Sardinia," recounts the story of the author's "changing epistemology." It reflects how Cassa navigates her way as an ethnographer to the Sardinian permaculture movement and how she works and discusses with practicing permaculturalists; how she herself then becomes involved with the movement and how it has affected her thinking. Through fleeting, practical encounters, Cassa provides glimpses into how the general ethical principles of permaculture ("earth care, people care, and fair share") are turned to praxis in rural Sardinia by combining traditional local customs and cutting-edge probiotic practices. Cassa illustrates how the international permacultural movement has provided a means for people living in the Sardinian countryside to reconnect with the land and to resist extractivist and exploitative forces from mainland Italy. For Cassa, as well as for the permacultural movement within which she works, symbiotic microbial communities represent an ally but also a reference model for designing a healthier world.

Veera Kinnunen's article, "Speaking with Microbes: Smell as Transspecial Conversation," forms a bridge between the garden and the kitchen as sites of engagement. The article draws on ethnographic fieldwork among bokashi composting practitioners in Finland. Bokashi is a method for handling organic waste through fermenting. It originates in Japan and has been gaining popularity in urban areas in the global North. Kinnunen explores how bokashi makers attune themselves to the needs of waste matter in a sensory and visceral way. She notes that the sense of smell becomes a vital sensory modality for engaging with and reaching out to the invisible microbial communities "working" in the fermenting matter; she argues for an understanding of smell as a form of transspecies communication.

…and in the Kitchen

In their article "In the Company of Bread: Sourdough Baking as Symbiotic Care," Ragnheiður Maísól Sturludóttir and Jón Þór Pétursson examine the cultures of sourdough bakers in pandemic and post-pandemic Iceland. In Iceland, as everywhere in the affluent North, the shutting down of the world during the Covid-19 pandemic was not only experienced as a collective disaster, which it of course was; for those with the time and means to stay at home, it also provided a possibility to go back to basics in one's own life and to engage in meaningful action, such as culinary experimentations or home gardening. Paradoxically, safeguarding citizens from a pathogenic microscopic agent made them seek connection with other, more "friendly" microscopic agents, such as *Saccharomyces cerevisae*, the yeast that has been used to leaven bread. In lockdown conditions, people had time to tend to and cultivate homegrown sourdough starters instead of using industrially produced yeast. Drawing from rich ethnographic material, Sturludóttir and Pétursson suggest that sourdough baking can

be conceived of as symbiotic care as it demands temporal commitment and careful interspecies collaboration. They illustrate how sourdough making demands allying with living organisms, the sourdough starter, which the bakers often affectionately call "the mother." Research participants humbly admit that they cannot fully control the life of microbes, only create suitable conditions for them by pacing their routines and living conditions optimally for the sourdough starter to thrive. Passing the sourdough mothers as a gift to fellow bakers or next-of-kin creates microbiological as well as emotional bonds and kinships between human and microbial communities across time and space. Moreover, the sourdough bakers considered their baking a form of care, in the sense of taking care of others but also of themselves. It allowed the bakers to engage in an emotionally meaningful, corporeal doing that allowed them to slow down from the hectic pace of modern living and tune instead into the symbiotic rhythm of the sourdough mother.

Lindsey Foltz's article, "Microbial Entanglements in the Bulgarian Cellar: Control, Collaboration, and Quiet Food Sovereignty," provides a somewhat different perspective on fermentation practices. Whereas the other articles study practices that re-connect with microbial heritages or adopt and develop novel relations with microbes, Foltz examines East European "cultures of cultures" that have thrived for centuries. Under socialism in the 20th century, fermenting and preserving food was not only a common means of securing nutrition but also a way of pursuing a meaningful life and establishing social relations. Foltz examines fermenting as a social practice in contemporary Bulgaria that is intrinsically linked to other practices of everyday life, such as shopping, gardening, gathering, cooking, and eating. The article explores sustained practices of domestic fermentation in post-socialist Bulgaria and argues that food preservation provides a sense of sovereignty and safety under circumstances of chronic uncertainty coupled with a tradition of mistrust towards corporations and authorities. Due to the unbroken tradition of home preservation, "cultures of cultures" related to food preservation have flourished up to the present day, including the embodied skills and the microbial cultures needed. Therefore, Foltz proposes that the fermentation vessels of Bulgarian homes could be treated as a form of "biocultural refugia" (Barthel et al., 2013), "microcosms of diversity made in collaboration between humans and their more than human counterparts from fruit flies to bacteria and yeast" (**p. 111**).

In the final article in this issue, Bryndís Eva Birgisdóttir, Áki Guðni Karlsson, and Jón Þór Pétursson explore together the effects and affects of dietary transformations in their article on "Fermented Living: Challenges in Adopting a Fermented Dietary Regime and the Role of Food Memories in Acquiring New Tastes." Their article is the outcome of interdisciplinary collaboration between nutrition scientists and ethnologists. The collaboratively conducted dietary intervention study examined the effects of fermented food consumption on 120 voluntary research participants. The analysis combines microbiological research methods to measure change in the composition of the intestinal and skin microbiome, metabolic-related markers, inflammatory factors, and metabolomic patterns, with social scientific methods, such as qualitative questionnaires and semi-structured interviews. The article presents a qualitative understanding of challenges that faced research participants and hindered them in adopting

a new diet, despite its health-claims. The authors illustrate how interviews highlight the underlying motivations, expectations, and fears of the participants, which may have a direct but otherwise invisible effect on the outcomes of the study. The authors point out that lay understandings of "healthiness" sometimes contradict the logics of nutrition science.

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To conclude, this compilation of empirical articles illustrates that microbiosocial relations are not formed in a vacuum, but co-shaped in relation to other species, environments, practices, and histories. As Amber Benezra (2023, 17) aptly remarks, the composition of the microbiome is affected by "how and where we are born, what food we eat, who we live with and love." Microbes are transferred laterally, crossing bodies and boundaries, creating bonds and kinships between species and kinds who share nutrition, living environments, and breathe the same air. From the microbial point of view, then, the borders between "inside" and "outside," "human" and "environment" are always fuzzy. Therefore, the cultural analysis of "cultures of cultures" (Brives et al. 2021; Hendy et al. 2021) calls for an ecological approach, which steers analytical focus from individual humans to multispecies collectives and how they co-shape their conditions and environments. Empirical research on microbial relations also makes it very clear that we are never alone, neither in life nor in science; we have no other choice, therefore, than to learn from other fields and seek fruitful dialogues across disciplinary divides. Because, unlike our universities, life itself is interdisciplinary.

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Compostories: Exploring Narratives of More-than-Human Relations in Soil Communities

Helga Ögmundardóttir
University of Iceland

Eysteinn Ari Bragason
University of Iceland

Abstract

Composting organic materials to turn them into soil or fertilizer for plants is an increasingly common practice in countries like Iceland. There are many reasons to compost and a variety of driving forces behind the practice. In this article, the focus is on the more-than-human relations found in and around the compost heap and the following research questions are answered: What kind of stories emerge by discussing composting? What are the main themes, who are the main characters in these narratives and what other stories emerge through people's stories of their composting? The article is built on qualitative data about composting, gathered through interviews and an ethnological online questionnaire.

Keywords: composting; human-microbe interaction; more-than-human relations; infrastructure; qualitative; narrative

Introduction

Composting organic materials to turn them into soil or fertilizer for plants is an increasingly common practice in countries like Iceland where affluence and consumer behaviour creates copious amounts of food waste. Humanure—organic matter from toilets of any kind—joins other organic material streams which these societies are trying to manage in a global environment that is increasingly threatened and threatening. In this article we focus on composting, building on our research in Iceland. Composting has recently been gathering momentum in Iceland but is in many ways a rather underdeveloped practice, especially in terms of waste management in the form of large-scale composting by municipalities and other such entities. Privately, many people all over the country have been composting their organic waste from both garden and kitchen and a few their toilet waste, some even for decades. In compost projects the individual and the communal meet in a social atmosphere increasingly focused on reducing waste, combatting climate change and protecting nature. Other drivers are, for instance, people's interest in their physical and mental health and creativity, and through composting, people find ways to practice and care for these.

Cultural Analysis 22.2 (2024): 17–36

Organized management of solid waste, such as food rests, with the aim of recycling and composting, had a slow start in the 20th century in Iceland. Throughout and towards the end of the period its fate was mostly in the hands of individual households and companies, some maybe burned somewhere far from human dwellings, but almost all of it ending in landfills on private land or in areas designated but poorly regulated by the country's municipalities. In the rural areas people would use food rests to feed their animals, such as dogs and chicken, but organic waste produced in urban areas ended up in the homes' only garbage bin along with solid waste of any other kind and from there in the already mentioned landfills. Organic waste that was not useable for the rural household's animals had for centuries ended up in the farm's midden or mound (*bæjarhóll* in Icelandic) that was gradually created under and around the turf houses which Icelanders lived in from settlement times, in the 9th century, and well into the 20th century in many areas. There is thus a short time span, only a few decades, from the house midden to today's solid waste sorting, recycling or reusing, and composting of organic waste that has very recently gained such a momentum that the majority of the country's organic waste is collected by the municipalities and then composted. This development has taken place not least because of the implementation of EEA's landfill directive and a following domestic law, implemented in January 2023, stating a ban on placing biodegradable waste in landfills, thus making composting an attractive option (Lög um breytingu á lögum um hollustuhætti og mengunarvarnir, lögum um meðhöndlun úrgangs og lögum um úrvinnslugjald, n.d.).

In this article we build on qualitative data about composting in Iceland gathered through an ethnological questionnaire, sent to the general public, as well as with interviews with people who compost, most of whom were recruited through Facebook groups where composting, gardening, soil reclamation and related issues are discussed, but also through snowball sampling. This particular research on composting is a part of a larger project titled *Symbiosis: Human–microbial relations in everyday life*, which is a three-year interdisciplinary center of excellence, gathering researchers at the University of Iceland, Matís, the National Museum of Iceland, and various companies, institutions and entrepreneurs in the country who work with microbes in food production, waste management, and for medical and health purposes. The work package of *Symbiosis* focused on composting is named *Living Earth: Composting as Human-Microbe Interaction, Cooperation, and Communication*, stressing the more-than-human presence and agency of microbes in the process of creating soil from the organic waste that humans leave. The disciplines involved in the research project, which is inescapably inter- and trans-disciplinary, are microbiology, folkloristics, food and nutrition sciences, and anthropology, to name the main ones, and the project is financed by the Icelandic Center for Research.

There are many reasons to compost and a variety of driving forces behind the practice; in this article, however, we focus on the more-than-human relations found in and around the compost heap and provide some answers to the following research questions: What kind of stories emerge by discussing composting? What are the main themes, who are the main characters in these narratives and what other stories emerge through people's stories of their composting, or "compostories"? To answer these

questions, we look into how people talk about, perceive and relate to their compost. Furthermore, we explore how people describe their relations to the organisms that turn food waste and humanure into fertile soil; these creatures that often are invisible to humans but who leave "traces" of various kinds, in the end truly transforming our world and making it livable.

Theory

Composting has emerged as a metaphor that provides critical insights for rethinking human relationships with the world in this era commonly referred to as the Anthropocene. Feminist scholar Donna Haraway (2015) emphasizes the need to make kin, as we are "compostist[s]," not post-humanists, she insists. For flourishing multispecies futures, humans need to commit to labor, play, and collaboration with their companion species, "becom[ing] with each other, compose and decompose each other" (Haraway 2017, M45). For Hamilton and Neimanis (2018, 501) composting informs a feminist methodology that enables accounting for messy and undervalued work of discarded scraps, and a scholarship for "growing different kinds of worlds."

Composting is central for Jones' (2019) hopeful approach for ethnography in the Anthropocene, where paying attention to rebuilding and regenerating reveals the new values and entanglements that sprout in unruly edges and disturbed landscapes. This

> …requires a careful (and care-full) tending and attending to those making the best of the mess that's been made: a commitment to noticing things not (only) falling apart, but (also) coming back together again. (Jones 2019, 4)

Engaging with composting reveals the inherent complexity of environmental relationships and challenges the idyllic notion of harmonious cohabitation. For Abrahamsson and Bertoni (2014), composting reveals "the 'dirty' side of the 'green'". It is all about togetherness and coexistence, not necessarily a cozy and comfortable version. It is a messy and complex but productive and continuously ongoing set of processes and activities involving numerous entities, such as microbes, earthworms and humans.

> In the dirty and messy togetherness of compost, constructing a common world is not about bridging differences, bringing about similarity, understanding and agreement. The togetherness of the bin is political, in that it calls for assembling, arranging, composing, separating, and working with others." (Abrahamsson and Bertoni 2014, 143)

Further, building on Puig de la Bellacasa's (2019) feminist philosophies of care, we discover a whole spectrum of relationality in the compost that ignites the imagination, creativity, and a sense of wonder among the human composters. In this dynamic micro-world, they encounter something bigger than they've experienced before. Puig de la Bellacasa (2019, 400) frames it as an "invitation to sympathy in shared more than human matter, eco-commoned by biogeochemical processes that return compounded matter to elementals, counters the individuation of anthropocentric earth as 'our own

creation'."

Composting defies scale, it stretches the familiar linear time, and it challenges the composter's identity and individuality, even the very agency of humans as creators and controllers of earthly matters. Composting brings with it an alternate sense of time, as Saltzman (2005, 67–68) continues: "Composting requires time, oxygen and mixing, and the result does not appear immediately in neat ready-made packages." The issue of time and how perceiving and practicing composting wraps it into a circular and irregular temporality is an even more striking feature of this messy and relational activity (Abrahamsson and Bertoni 2014), or as Barlow and Drew (2021) phrase it:

> The (post)colonial logics of speed and convenience are manifest in many of today's infrastructural projects, creating what we consider to be 'fast infrastructures'. These infrastructures create ease for some and harm for others while exacerbating social and environmental crises around the world. Addressing these crises, we argue, a slowing down. Enter the role of 'slow infrastructures'. (Barlow and Drew 2021, 212)

In relation to time, composting is an example of a slow infrastructure. With the slowly flowing and circular temporality of composting comes the ever-increasing intimacy between the composter and their compost, with its communication with, care for and knowledge of the organisms and really the whole micro-world of the compost heap.

In the broader scientific discourse on multispecies soil making, Meulemans (2020, 101) evokes the living soil approach and reveals that soil is far from an inanimate mix of materials. Soil is rather something that grows out of intra-active relations of organisms, minerals, water and air, "constantly transforming each other into something else." It can be argued that co-creating soil with the microbes, through composting, is a democratic project, as it literally and metaphorically puts us all on the ground—and in the end in the ground. It makes us all equal since none of us is at the center, more important nor more powerful than the others. In fact, and as many of the survey correspondents in the research project acknowledged, the microbes are in charge, with the human agents only as facilitators, feeders and in some cases admirers of their formidable work. Ultimately, composting is a practice of sympoiesis (which means "making with"), where "beings–human and not–become with each other, compose and decompose each other, in every scale and register of time and stuff in sympoietic tangling" (Haraway 2017, M25 and M45).

Furthermore, Puig de la Bellacasa (2014, 65–66) says that it requires a "particular consciousness" or "spiritual wisdom" to acknowledge that humans are part of "a living organic web of being." She approaches soil as infrastructure to "reveal one of its dimensions, one of its modes of existence: that of a basic understated, stabilized, indispensable ground upon which a collective lives and works." Importantly, acknowledging and understanding soil as infrastructure gives an opportunity to "avoid some of the devastating effects of its breakdown" (Puig de la Bellacasa 2014, 66). If life on earth is dependent on healthy soil, we need to properly maintain and care for this infrastructure and realize that we only can do it in collaboration with the "invisible,

non-human, workers of the soil," as Puig de la Bellacasa (2014, 65) calls the organisms that break down organic matter. That gives us reason to reassess our relationship with these different organisms and likewise our relationship with leftovers, but many informants of this research said they had stopped looking at these materials as waste and began to see them as valuables. The breakdown of organic matter into soil leads some informants to ask critical questions about other man-made infrastructures and systems, such as those relating to waste management which didn't seem to match and even damage this "bioinfrastructure" of the soil. Thus, throughout the process of breakdown, infrastructural breakdown is brought to the center of attention.

But let's look a little closer at infrastructure, slow and maybe even a little fast. The Kilpisjärvi Collective introduces the term "withnessing" in their Introduction to the book *With microbes* as a way of knowing microbes and their relationships with humans, how these two organisms entangle, embody and accompany each other (The Kilpisjärvi Collective 2021, 18). This term stresses the importance of employing a multiplicity of methods and approaches to studying human-microbe relationships and interaction, because conventional research methods are inadequate, being anthropocentric, hierarchical and denying microbes the agency they truly have. Withnessing, on the other hand, "is about knowledge as situated, immersed and partial" (The Kilpisjärvi Collective 2021, 24). To withness the symbiosis of microbes and humans one has to "focus on practices and processes, rather than outcomes only" (The Kilpisjärvi Collective 2021, 25) and these include the participants, tools and devices employed when and where the interaction takes place. The composting box, heap, container or whatever vessel we use to shelter and feed our microbes and their animal companions is a prime example of such a site. The composting site is an infrastructure like no other, with an endlessly creative and changing design, depending on who, why, where, and when is involved, constantly influenced and shaped by both human and microbial actors. The researcher becomes an integrated part of the withnessing that takes place in and around the compost, where sharing of everything is inevitable and the withnessing becomes the only approach possible to perceive and understand its magic.

Fortunately, for the study of composting, there is an increasing interest in infrastructures of all kinds in the social sciences and humanities. The authors of this article have benefited greatly from that in their search for suitable theoretical tools to understand composting as a symbiotic relationship and project, where humans and more-than-humans meet on non-hierarchical ground with a culture of care and curiosity as their guiding light. We end this theoretical contemplation with some remarks inspired by Kinnunen and Valkonen (2022) from their chapter "Approaching Infrastructural Being," where they convince the suspicious reader that infrastructures are not only possible sites to find, where humans and microbes interact, but even necessary ones to witness such interactions. This is because these infrastructures have an ability to unite different temporalities, materialities, cultures and disciplines—the absolutely necessary components of 21st century research for a world that desperately needs new approaches to tackle the new normal of climate change and other environmental challenges. The composting infrastructures where humans meet their microbial and other other-than-human collaborators, in the common project of turning organic materials

into soil, are sites where the individuality and boundedness of those involved are challenged. As Kinnunen and Valkonen (2022) state, infrastructures are socio-material technologies, sites of power-struggles and they are

> naturecultural entanglements in which humans are not just rational users or designers of technologies acting upon their environment, but their bodies and practical ways of dwelling are also being shaped in the process referred to as infrastructuring. (Kinnunen and Valkonen 2022, 19-21)

The composting process disturbs the perceived permanence and stability of smoothed out infrastructures where established hierarchies, with the human on top, are turned upside down. In the compost heap, matter transforms according to its own infrastructures and temporalities, not the human one.

Method

The methods used for collecting the data on which this text is based were qualitative, consisting of an ethnological questionnaire that was made available to the public through the web interface of Sarpur,[1] a culture-historical database and information system for the museum sector in Iceland. Qualitative questionnaires are a well-established research method that Audun Kjus and Line Grønstad describe as a kind of interview where the conversation takes place in letter form. In recent years, these surveys have increasingly been conducted online (Kjus and Grønstad 2014), as is the case with this research. Other methods, producing supportive data to the answers of the questionnaire, were semi-structured interviews with people who compost and/or are somehow linked to composting practices and projects, as well as participation in online groups on social fora, such as Facebook, where the researchers took part in conversations and recruited interviewees. We also used the snowballing method to find new interviewees, asking participants to put us in contact with people they knew were practicing composting. The data was gathered between 2021 and 2023, and the questionnaire is still open so additional material will be analyzed for the next step in the project. Last but not least, it bears noting that both authors are ardent composters and that participant observation, both of self and others, is a vital part of the information gathered.

The questionnaire, written in Icelandic, consists of over 40 questions and subquestions in 5 theme-related chapters and people are asked to answer as many as they want (see Appendix 1 for details), often resulting in detailed first few answers with the latter part of the questionnaire less well answered. This is of course not always the case, fortunately, and the answers are rich with ideas and information, often nuanced and eye-opening to read, code and analyze. What we present here is just a fraction of what the ca. 140 participants expressed, selected according to the themes we chose to follow. Respondents were given the option to state their name, residence, place of birth, age, etc., but many didn't or only revealed their identity partially. We don't use their names when quoting them directly since the exact identity of the participants is

not a focal point in this research, whereas we sometimes mention the age, gender, occupation, etc. of the participants if these seem significant in any way for interpreting the answers, not least when respondents used these factors themselves to explain their ideas and practices. The 14 interviews gave us a chance to probe deeper while giving our interviewees freedom to tell their compostories in their own way, after having asked some specific questions. The interview questions are listed in Appendices 2 and 3.

The Multiple Faces of Composting: From the Personal to the Global and Everything in Between

In this chapter, we present, describe and analyze some of our findings from the questionnaire and interviews carried out in the compost work-package of the Symbiosis research project. We divided the themes that emerged from the respondents' answers into several subchapters which show the profound existential, ethical, social, physical and psychological effects that composting and relating to soil in general has on the practitioners.

The Importance of Composting: Why and Where Does it Come From?

Composting organic materials from the home is deeply personal. Many respondents expressed this view by comparing the practice, for instance, to yoga, meditation and mindfulness, and describing it as a way to connect to nature. The answers expressing these views were phrased in various ways: composting fulfils an "inner need and interest in nature"; it "is the best meditation, to dig through the compost, seeing waste become valuable material"; and "I do yoga and like to grow my garden, my animals and my children. I think it's all connected," to name only a few. Engaging with the organic material, noticing the transformation from waste to valuable matter, had, for some, a spiritual dimension that brought well-being and was connected to growing, whether it was in your garden, other beings, or yourself. It allows one to follow one's values and connect to something greater than oneself: "My composting started out of a strong desire to make good use of all resources. Reduce household waste and live in greater harmony with the environment." Taking care of what you leave behind and treating it as something valuable, as a resource instead of a waste, was seen as a way to build a spiritual relationship with the environment.

Along with this spiritual, or ideological, motivation for composting, people also mentioned pragmatic reasons for taking good care of resources and starting to compost, such as having direct access to good soil and a fertilizer for gardening and forestry, but commonly in reference to environmentalistic aspirations: "... the household's need for soil is high and soil is quite expensive, and it is not environmentally friendly to import soil into the country." The respondents sometimes articulated their desire to see themselves as living sustainably. The act of consumption in our affluent part of the world is fundamental to that, since hardly anything we do to satisfy our basic needs is not bought in some way, directly or indirectly: "I have always been interested in sustainability and nature conservation. I also consider myself exceptionally practical,

which means I can't bear to see resources wasted". Composting was generally aligned by respondents with good and/or ethical use of resources and a sustainable lifestyle. To make your own soil instead of importing it to an island in the middle of the Atlantic was generally considered to make sense, both from an economic standpoint and an environmental and ecological one.

Interaction with other humans around and through composting—neighbors, family, workmates, people in compost groups to which respondents belong, etc.—were for many somewhat important, although the majority said that the relationships with these other humans weren't very important for their composting. They didn't really care about what opinions others had of it, nor did they talk much about it with others. Communication with others about composting was mostly to seek and to give information and advice. Some examples of how this was expressed are the following: "Discussions with like-minded people have often been interesting, but I have not been in the business of spreading any gospel. I don't care what other people think, I'm doing this for me"; "Support outside the home doesn't really matter to me other than that more people start turning garbage into gold—that should matter to all of us"; and lastly: "[I] haven't done much of it in general. To be honest, I haven't bothered, the discussion becomes so surreal when this kind of thing comes up." The personal aspect of composting is once again brought up and it has a link to self-care. It was rewarding to engage in composting and support from others didn't seem to be of importance; what was of importance was that others took care of the organic material instead of wasting it, seeing it as a resource. Still, most didn't want to preach composting, maybe due to "surreal" responses.

Some, though, made an effort to affect others: "I have also introduced composting to friends and family—spreading the gospel is part of it all." The significance of the organic material led this individual to influence more people to start composting. Calling it the 'gospel' suggests a spiritual and playful undertone and stories about how some people use every opportunity they have to talk about their compost and ask others about theirs do the same: "my wife laughs a little at me when I fall into long conversations with my friends about composting" and "I like to talk about composting and have even let guests at a dinner party sniff my trash! Kind of strange behaviour for sure but I was in awe of Bokashi." The wonder of transforming organic waste into compost makes these informants communicate with others in a way that some might consider odd.

It is interesting to note how others' opinions or complaints weren't important for the composters: "I think there is generally little understanding and interest in composting. It takes work. I think my neighbors think I'm a little weird for always messing around in the yard." It seemed that the composters would continue whatever others had to say about it. People also described how the practice of composting has rendered them unable to stop; however else their lives have turned out in terms of facilities and lifestyle, they mentioned they will continue for as long as they possibly can, or: "until I become organic waste and am composted." This strong bond with the compost and composting frequently came up: "I have felt bad about not being able to compost. I find it hard to accept having to put organic with other general household waste …

Soil is approximately the only thing I miss after I moved to an apartment building." Another informant wrote: "When I moved, I moved the compost (the green plastic bin) with me, with all the ingredients. I couldn't think of leaving it behind." Dedicated composters had a personal connection with the compost they took part in creating. It was not something to be left behind and it had a negative effect on the environment if they were forced to stop practicing it.

More-than-Human Relations: Material Knowledge and Hands on Learning

Some respondents noted tacit knowledge as an important factor in acquiring good compost. Knowing with the hand, experimenting, and learning by doing were of the essence. Many talked about getting a feel for the material through hands-on experience that accumulated through years of involvement: "it's not just something standard. You need to think and do experiments." Relations with the organic material, how it breaks down and composts, and hands-on learning by doing takes us from the technical to the sensual, where you learn to trust your senses to judge the composting process, here expressed thus by one of the participants:

> To understand the compost, I use texture and smell. Good compost is light, porous and with a lot of organic material, it smells nice but not sour, that happens if the material is too wet. Before I measured the heat in the heap, but I've stopped doing that.

Quantifying and measuring what is in the compost in terms of nutrition doesn't necessarily show the quality of the material; intuition and observation gives the whole picture:

> I once sent a sample to Hvanneyri [The Agricultural University of Iceland] for testing, but it was from a growing bed where I had added my compost. But I quickly learned to trust my own feeling based on smell and texture. I also knew exactly what went into the compost. My compost is the best nutrition for the crop.

In addition, people often used an emotional, sensual or even romantic language to describe their relationship to the compost heap or the organisms involved in the breakdown of the organic material: "First and foremost it's just love for the environment. Nothing is as romantic as the smell of the compost, the steam that rises from a warm heap on a cold day." The responses repeatedly mention a connection to the material itself, the soil or the compost, and sensuality runs through it all: "I connect strongly with the soil when I work with the compost, smell the soil, feel the texture and see how the plants benefit from receiving compost. In that way I feel like I can sense Mother Earth." The soil had an affective presence. Many believe that touching, feeling and smelling the soil, actively engaging with it and witnessing the transformative composting process contributes to good health: "it's hard to describe that connection, but I feel they do me good directly and indirectly. Through the soil and knowing about the healthy soil life around me. I like touching soil and smelling it."

Trust is another issue that many respondents mention in connection with the process of composting, that is, what happens in the compost after they put the organic matter there. They said they trusted the process and had faith that everything would take place as expected without their meddling in it or having to worry about or monitor it. They said they trusted Nature; she would have her way and do what was necessary to create fertile compost: "It just takes care of itself with the help of water and sun and the industrious earthworms who surely have an army of tiny creatures with them." This trust is fundamental and interesting, not least when we consider the context of culture and society in which the respondents live: the composting they do takes place in one of the most affluent countries in the world which is industrialized, highly technological, individualistic and where people expect most of their lives to be under control–predictable, safe and managed. As one informant commented, "compost heaps are great behavioral training for people who think they can control everything in their lives. You have to trust the process." Composting teaches you, or trains you, to let go of this tendency to be in control all the time; ultimately it sets you free, which is the reward for letting go: "Composting and gardening are very good for mental well-being. Calms the mind, gives you freedom because there are no rules about how your garden is supposed to be. It's like the only area of life where one finds complete freedom of choice." The compost heap seemed to offer a safe space and a relief from worrying from not being in control–things will turn out as they should because Nature sees to it in this collaborative project of withnessing.

More-than-Human Relations: Caring, Communicating, Interacting and Imagining the Soil Community

People had many stories to tell when asked about their interaction with the more-than-human organisms involved in composting and who live off or in the compost mass, such as mice, birds, earthworms, insects and other small animals, and last but not least microbes. Their focal points ranged from acknowledging the presence of microbes to total ignorance of any organisms of that sort. Some found it extremely difficult to imagine a relationship, feelings towards or interaction with microbes: "I try to answer this seriously even though the questions are getting stranger and stranger. The microbes do their thing and I do mine. We don't interfere with "each other"." This informant talked about himself and the microbes as separate beings that didn't cross paths, at least not on a conscious level. Some respondents characterized the questions that dealt with human-microbial interactions and relations as "very strange," "spaced out" and "ridiculous."

But we also got answers from people who clearly did experience an affective relationship with microbes: "I often feel some kind of a connection with the microbes. Or manage to tune in to some wave and perceive them better. It's a bit like buzzing or dizziness maybe. … A moment when one gets a feel for ecology and is able to read processes in the environment." This kind of an expressive response, however, was more of an exception in the questionnaire materials. The interviews, on the other hand, gave opportunities to ask in more detail about more-than-human relations and

one dry toilet enthusiast described how he related to microbes:

> I began to understand the context of the microbes—that microbes are a big part of the biosphere. They perform more than half of the photosynthesis that happens on earth. And microbes are not only on the surface, they are found at ten kilometers depth. Microbes are everywhere and we are partially microbes.

With regard to his dry toilet and composting the dry toilet material, this interviewee then added: "To be able to do this you have to study it and just be part of those microbes. And recognize yourself as them. They are the basis of life." Microbes were a crucial part of his lifestyle and his understanding of ecology, and it was clear from his response that an awareness of microbial life and of his relationship with microbes was both essential to his practice of composting and something that came about through composting.

Many questionnaire respondents were more aware of micro life in the form of insects and smaller animals like mice, rather than the microbes or fungi: "I don't want to kill bugs and I apologize to the earthworms if I accidentally hurt them … I'm most worried about putting a shovel or fork in a mouse nest though, that would be horrible." Most informants that described a relationship with the more-than-human organisms in the composting process seemed to form a stronger alliance with worms or other beings that they can see with their bare eyes, rather than with microbes. All micro-life is not equal, though, as some respondents poisoned mice but welcomed birds and earthworms to the compost. More-than-human relations were thus not unconditional, for in some cases unwanted beings, such as rodents, were excluded: "Once mice came into the box after I threw away a lot of bread. Then we got pest control to come and poison. I haven't seen any mice since." And another example:

> Mice have burrowed under the bin, but in the winter, I always put mouse poison right next to it, luckily, I haven't come across a dead body in the compost. … A very welcome guest is a blackbird who stays in here during the winter, he is often seen around the compost bin.

Some of the answers framed microbes and other non-human actors as companions to be cared for, as "good neighbors that deserve some kind words and thoughts every now and then". One might even cook for them, like a woman whom we interviewed who confessed that unconsciously she was sometimes more concerned about what leftovers might benefit the compost heap rather than what the household members might prefer: "I realized I had sometimes been cooking for my compost pile. Something like, "yeah, it's missing ..." you know. Then I'll just make a good vegetable broth [laughs]. And then, suddenly: "Yeah, was I doing that?!"" Caring for the life in the compost will reward you later: "If you are dealing with any living beings then you need to show them care. Your plants, your carrots–and if you do, everything grows and thrives." Thus, the caring narrative took on many forms, and metaphors were abundant:

> I often think about composting as farming with animals that I can't see but I know the animals need oxygen, nourishment and moisture. And I notice the fruit of their labor when I see this fine soil that they have made. … I admire their work, it's quiet like the way of life … My role is to make sure the animals live in a good environment, just as a dairy farmer knows he has to take good care of his cows.

Although this quote conveys humility and respect for the course of life and brings forth labors that Puig de la Bellacasa (2014) maintains most humans do not recognize, it also conveys the imbalance of power that the divide between man and nature implies, where humans are in control and microbial beings are harnessed as cattle, rather than seeing them as allies or relatives in the bioinfrastructure of the soil.

Regeneration: What Goes Around Comes Around

A fascinating finding of both the questionnaire and the interviews is how widespread the understanding of composting as a creative process is. Descriptions of people creating something when composting–when remnants of food and plant parts turn with time into black, fertile soil–often involve both the creation of the composting facilities and the compost material itself. Respondents describe how they make the compost structure, all the way from choosing the site and designing the structure to building the composting container out of wood or buying a plastic one. Some provide wonderful details with obvious joy and satisfaction. One describes the practice as "an outlet for creativity and a little hands-on science." This creating is an important part of the process; the composting itself may be described as its culmination and the heap of living soil as its product. Many also described in detail their composting activities, how they watered the material when it was dry, how they stirred it to mix the different ingredients and to increase the airing for better results, how they moved the compost from one compartment of the container to another as it changed with time, and so on. All described this as a labor of love; as labor that doesn't make people tired in the conventional way, even if it is sometimes physically straining, but gives satisfaction and leaves one content. This creative act gave them energy and tranquility. This creative force even extends to new generations: "When I have managed to engage the children, e.g. to garden and they are using their own compost, I think that gives something extra," and, "I consider myself to be growing human beings as well." Spreading awareness, skill and knowledge encourages relational thinking and doing and keeps the cycle going.

A relationship with these residual substances and the organisms involved in the decomposition includes creation, since the decomposition of organic matter is a prerequisite for life on earth: "What fascinates me the most is seeing the transformation, from "rubbish" to fertile soil, the vegetation grow and to participate in the cycle that takes place. I do this because it gives me so much." To take part in this cycle is nourishing both mentally or spiritually, as mentioned earlier, and physically: "I also enjoy seeing the cycle of organic matter that I've managed to collect and transform. Last but not least, my worms are fattening up well in this energetic compost which has pro-

duced beautiful fish. Which are eaten with freshly picked potatoes." While this may seem like an anthropocentric view, it describes the cycle in which all living things live, and humans are no exception:

> I think the biosphere is almost like one big compost bin. All nutrients are recycled. Nothing is left out. You are always welcome at the microbes. They will always return you to where you belong. For you are dust, and to dust you shall return. I shudder at the thought of space travel and Mars and the Moon because what happens to the bodies that die out there? They will never be returned.

The scale is massive, from the underground to the planetary. The worldview of the compost bin as a microcosm to the planet's macrocosm is presented with microbes as a force that in the end of a lifespan transforms the human body to where it belongs, to where it came from, back to the Earth.

Responding to Failing Infrastructures

Composting brings forth stories about climate change responses and failing infrastructures. Moreover, the stories suggest ways to take responsibility for our own personal waste and testify to a longing for a society that does the same. Some informants mentioned that their composting was a response to consumption patterns, pollution and climate change; it is their contribution to mitigation and to making good use of resources by not throwing away and wasting the precious materials that food scraps in fact are: "I prefer to call it a product rather than waste, since it's important to keep the cycle going. The food you eat comes from the Earth and this way I can do my best to return what I took."

As mentioned earlier, some informants expressed a desire for sustainable consumption, not only in their personal life but especially on a societal level. Food waste reduction in general was also connected to the large-scale effects of wasting food in our affluent world. For example, one respondent claims to be "overwhelmed by the consumption and alienation in most aspects of society" while another notes "how ridiculous it is to put all the trash together in a plastic bag and put it in a landfill, in no way sustainable and just completely crazy." Respondents agree that current waste infrastructures and the social norms associated with them do not support practices of sustainable consumption and composting:

> I have a strong aversion to food waste and am a hardcore dumpster diver. I even take food from there just to throw it in the compost bin. The ethical use of resources is important to me. And so is my connection to my environment. … I can't believe that all this food just goes to landfill?

Concerns about consumption and wasted food include a criticism of the conventional waste collecting system, where organic leftovers are thrown into landfills while soil and fertilizers are then bought in a store.

Landfills are the most common method for getting rid of organic waste in Iceland, problematic as this form of disposal wastes resources and emits greenhouse gases. Respondents consider composting, either at home or in facilities managed by the country's municipalities, as a solution to that. The rewards for improving a failed system by composting are to receive fertile soil without much expense, an economic argument seen as important on both a personal and a societal level. Landfills were considered particularly wasteful, given that soil erosion is a massive environmental problem in Iceland (Ólafur Arnalds 2008), a subject of heated debate about the islanders' responsibility for keeping the ecosystem functioning and in a similar shape as it was before humans settled the country twelve hundred years ago: "We live in the largest man-made desert in Europe. And have one-fifth of vegetation cover from the time of settlement. But still, we think we are environmentally friendly." But soil erosion is not only a local issue: "I find it sad that these valuables just end up in the trash especially since soil erosion is one of the biggest threats to the planet." Many were critical of society for not taking better care of its valuables. Some say they use their compost to improve the soil on eroded pieces of land, often situated on their private summer house lots or their family's farmland.

This critique of society becomes even clearer when considering the organic material that goes down the drains, from our toilets, away from humans to other locations where it becomes a source of pollution: "What I find serious is how much valuable fertilizer goes through the drains and out to sea. Where it becomes pollution instead of being used for necessary land-reclamation."

> There is active soil erosion, and nothing is being done about it. Instead of using this great product it's driven all the way to Reykjavík. And it's more or less all from tourists from abroad. It's either disposed of at a landfill or pumped out in Faxaflói. At our expense. I just think it's so stupid. … By dumping our products to Faxaflói we are polluting what used to be the best fishing grounds in Iceland.

Through a composting process that involves human and microbial action, the problematic waste can be turned into a valuable resource, a treasure that fertilizes the soil. This argument is a critique of modern waste disposal systems, on the one hand, and of chemical soil fertilization on the other. Composting in general, whether of garden or kitchen leftovers or, indeed, of humanure, goes against the grain of linear thinking and the commercial logic of contemporary Western society. As such, it involves a degree of activism, articulated to varying degrees by the people who responded to our questionnaire or gave us interviews. Composting is to create for the soil but also to create an alternative to an economic and environmental regime whose ultimate product is landfill.

Conclusion

We end with the wise words of Puig de la Bellacasa (2019) when she describes what our relationship with soil does to us, embracing the boundless life that relationship

includes and brings to existence, our life too, among the countless others:

> [H]uman-soil relations also (re-)animate in the sense of *raising spirits up*. From the lure of wonderful soil biological worlds and its teeming wonder, to the embodied hope of eco-poietic everyday soil care and joyful sensual proximities, in the promise of a composted afterlife, these stories speak of joy, hope and possible versions of humanness other than the world destroyer. (Puig de la Bellacasa 2019, 403-4)

Whether the participants in the study were conscious of their microbial co-composters or not, more often acknowledging their somewhat bigger invertebrate collaborators, the entirety of the composting site is impossible to be perceived and understood without witnessing everyone involved—from the zillions of microbes inhabiting the place to the neighbor's dog who comes regularly to sniff out the latest food rests and leave his urinary calling card. Like every ecologically vital process, it encompasses both the scales of size and time that go beyond human cognition. The composters realize that, eventually letting go of their modernistic anthropocentric urge to be in control of everything and everybody to trust the process instinctively. And the reward is imminent: joy, hope, creativity; physical exercise, better health; togetherness with nature; contentment, harmony, loss of sense of time and place that relieves one of stress and worry; company with one's family, neighbors, friends; endless material for storytelling and educating; saving money, usefulness; participation in environmentally friendly behaviour and climate change activism—and the list goes on.

One more theme that has to be mentioned because it goes beyond anything the researchers expected to find in a practice that involves humans and other-than-humans in making soil out of food rests: composting brings the existential issue of the inevitability of death to the consciousness of the composter in such a way that it becomes natural, understandable and even poetic and beautiful. Composting also enables us to see life on Earth collapse with life on other levels, whether in outer space or inside every one of us, humans, microbes and all those in between. When you think about it, perhaps the metabolic infrastructure of composting your organic waste, and ultimately yourself, should be the only one we build; any other is just a temporary illusion between when we're born and when we die.

Notes

1 *Sarpur*. See, https://sarpur.is/Svarsnid/Grunnupplysingar.aspx?SpurningaskraID=2314665

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Appendix 1

The questionnaire consists of five chapters with a various number of questions, divided thus:

Chapter 1: Description of composting and composting facilities.
• Describe the composting you practice. • What kind of organic waste do you compost? • What do you not compost and why? • How long have you practiced composting? • What kind of facilities do you have for composting and how have you created them? • What have been the main challenges and how has your composting unfolded? • Can you describe the process from the gathering of the organic waste until it has transformed into soil? Examples would be what you do (seasonally, every day, weekly, monthly, etc.), where and how the organic materials are collected and stored, the participation of others in the home?

Chapter 2: Reasons, attitudes and experiences.
• What led to your practice of composting? • Where did the interest come from? • Did you become interested suddenly or gradually? • What was your first encounter with composting? • Has your life focus and attitudes changed since you started composting organic waste? • Can you give examples? • Have you experienced any changes since you started composting? Examples would be changes in well-being, behaviour and interests. • If so, could you describe these changes or give examples? • Does the composting practice have any connections with other interests or activities that you have? How? • Have you gotten acquainted with other people through composting? • Have you introduced it to others? • Has it led to conflicts? • What do your neighbors say? Can you give examples? • Do you experience support or criticism of your composting? Does it matter to you?

Chapter 3: The symbiosis of humans and microbes.
• Do you somehow evaluate the organic matter during the composting process and after it has composted? • How do you evaluate it? • Do you do some kind of measurements on the compost (based on smell, texture, looks or some other qualities)? • How do you envision the composting process in the mass/container? • What organisms do you think are involved and what role do they have? • Do you talk or think about the microbes in the compost process? How? • Have you given them names, or do you know of others who have done that? • Do you feel some kind of connection to the microbes? • Do you feel that you or the microbes are in charge of the process? • Are you worried about unwanted or harmful microbes?
Chapter 4: Information gathering and output.
• Where and how have you gathered knowledge about composting? Please include links to websites. • Are you a member of organizations or groups who focus on this issue? • Have you shared this knowledge with others? • On which occasion and how? • If “no”, why not?

Chapter 5: And finally.
● Do you envision continuing composting organic material? ● Is there something you want to add that has not been addressed already? ● What is your occupation? ● What is your education? ● Do you have any comments about this questionnaire?

Appendix 2

The interview questions used in the qualitative interviews about composting, directed at individuals and families, were the following:

1) How do you utilize organic waste? Where do you do that – inside or outside?
2) Do you both use organic waste from the garden and kitchen? If you use only one and not the other, then why? What material exactly do you use?
3) Please describe the whole process [ask people to take you to their composting area and show you how they do the composting; the physical activities involved, which tools they use, etc.].
4) Who participates and in which manner (family members, neighbors etc.)?
5) When did you start composting and how did it come about?
6) What do you do with the composted soil? Do you do any kind of measurements or evaluations of the compost? What do they consist of?
7) What problems or difficulties have you encountered in the process?
8) How do you talk about composting, for instance with relatives, neighbors, friends, workmates, etc.? How do they, in turn, talk about the issue?
9) Are you a member of any organizations or groups around the issue?
10) Does your composting relate to other interests and then which ones and how?
11) How did you seek information about composting initially and where did the idea come from?
12) How do you envision the composting process – the decomposition and transformation of the organic material? What happens inside the compost container/mass? Which organisms are involved and what role do they play, for instance microbes? Do you talk about them and then how?
13) Do you do anything else that involves microbes, such as making skyr, sourdough bread, kimchi, beer and so on?
14) Is there anything you want to add?
15) Would you allow me to talk with you again, for instance for more detailed information about your composting?

Appendix 3

The interview questions used in the qualitative interviews about composting and having a dry toilet, directed at individuals and families, were the following:

1) For how long have you had a dry toilet?
2) What kind of toilet do you have? How does it work?
3) Where did the idea come from? Did you do research before you decided on getting one?
4) How has it been? Have there been any problems?
5) Have you made any changes? Is there anything you would like to change?
6) Why do you use this solution?
7) Could you imagine having this kind of a toilet in your home?
8) How do visitors react to this?
9) Do you talk about such toilet solutions with others? How is it received?
10) Has anyone criticized this solution or commented on it?
11) Is there anything to watch out for? (Bacteria)
12) What do you do with the toilet waste?
13) How is the process?
14) What do you do with the compost?
15) Do you know which microbes are involved in the process of breaking down the organic material?
16) Have you monitored the decomposition process? Do you do any measurements?
17) Where does the knowledge of microbes come from? But the interest? What did becoming interested in microbes change for you?
18) Do you know of anyone else with a toilet like this?
19) Are you in any groups regarding this? But composting?
20) Have attitudes changed in society towards dry toilets? What about attitudes towards composting?

Setting the Table for Relatedness: Fermentation in Designing Permaculture Projects in Sardinia

Maria Giovanna Cassa
University of Sassari
Italy

Abstract

This article analyzes practices among a group of permaculturists in Sardinia, Italy. Their daily choices emerge as rooted in a specific understanding of the world that gives great value to their social and environmental relations. The ethnography carried out about fermentation of foods and soil compounds offers an entry point to this world ontologically founded on a particular way of budgeting costs and benefits between human and non-human elements. Microbes and their symbiotic colonies emerge not only as allies in designing a healthier world for future generations, but also as reference models.

Keywords: ethnography; Sardinia; permaculture; fermentation; relatedness; microorganism; alternative economies; alternative ontology

Introduction

> For ethnographers today, no task is more important than to make small facts speak to these large concerns, to make the ethical acts ethnography describes into a performative ontology of economy and the threads of hope that emerge into stories of everyday revolution. (Gibson-Graham 2014, 152)

As I was tying tomato plants in my garden, last summer, a few millimeters from my hand, was a yellow and black spider more than five centimeters long. Just a few years ago I would have been quite scared of such a spider, maybe tried to kill it or drive it away but this time I did not. I just stopped what I was doing, observed it closely, and consulted my network of friends as to what this spider's presence said about the health of my vegetable garden. My world had changed.

Figure 1. Wasp spider. Photograph by the author.

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This transformation, as deep as it was slow, began in 2019 when I began my research on permaculture in Sardinia.

This article, through people's stories, aims to open to scrutiny a different way of seeing our world, one in which humans are neither the main actors, nor the only ones allowed to act and "speak." The entangled threads of these different voices emerge from ethnographic data collected over the last four years among the network of people running permaculture projects in Sardinia, Italy. Here I propose a reflection on how permaculture enables the structuring of a new ontology of relations that can address rising environmental concerns; the focus on fermentation offers a glimpse on how, in a permacultural framework, microbes can be considered as part of a "nature" humans can learn from.

To this end, the first section will describe data collection methods as deeply interwoven with my experience on the island and of permaculture. The first section aims also to answer the following questions: how this movement took root in Sardinia and how it has taken specific meanings, and why the island is contextually interesting from an anthropological perspective. In the second section, case studies focus on human-microbe relations in permaculture projects and the importance given to interconnections within a system. In the third I will argue for a deeper understanding of how fermentation is integrated in permaculture discourse and ethics. The second and third sections delve deeper into the main research question: understanding microorganisms' collaboration in fermentation processes from the permaculture philosophical framework, do theyalso offer a model for people's actions towards their social relation? How does this contribute to locating human beings in a different position in the ecosystem? The fourth section moves up the scale from microorganism colonies back to humans and their communities and approaches the question: how have fermentation practices in Sardinia become a practice of resistance and resilience? In the Conclusion, I question people's practices as driven by a radical criticism of the Capitalocene (Moore 2015) moving from the ethics proposed by permaculture to a new ontology of relationships. The pivotal reflection driving the article is an analysis of how peoples' actions and choices on a daily basis are rooted in a different way of balancing costs and benefits in designing a permaculture project, generating an ontological shift, maybe an alternative "telluric force" (Stoppani 1873, cited in Crutzen 2006) based on the value of relations.

Before entering the article's core discussion, however, it is worth briefly explaining the use of some terms. Throughout the article I use the term "microorganism" to refer to microscopic living organisms too small to be seen with the naked eye, unicellular or multicellular, including bacteria, yeasts, molds, and fungi. With the term "microbes" I refer mainly to unicellular bacteria causing fermentation. I use "bacteria" in more specific discourses also naming the types, or when my informants themselves use the term bacteria. As for the terms "identity" and "tradition," I consider them as categories, "floating signifiers," from time to time filled with different meanings in people's accounts.

The use of the term "nature" is also particularly slippery and filled with different meanings depending on who is using the term. Generally speaking, asking a permac-

ulturist if humans are nature, he/she will answer unquestionably "yes." On the other hand, one of the main permaculture principles (Holmgren 2002) is: "work with nature and not against it" introducing a sort of separation between the two elements. This somehow suggests that humans are "natural beings out of nature" because of loss of consciousness, skills, and competences once present but now forgotten. Therefore "nature" seems to be a complex meshwork of relations occurring between each element of the environment (bacteria, animals, vegetation, winds, waters….), sometimes including human beings, sometimes not; "nature" is something humans must model their actions on, something to return to be part of, fairly and effectively. The issue then seems to be to undermine the centrality of humans, considered just one element of the system, able to ecologically give to and take from the other elements.

I use the term "environment" more than "nature" to refer to a complex system encompassing all the aforementioned issues. The term "Capitalocene" proposed by Moore (2015) pushes forward the reflection about the Anthropocene, a widely used concept today also in mainstream discourse and a clear reference term for people trying to act differently towards environmental systems. The term "Anthropocene" created a new urgency for "talking about, theorizing, modeling and managing a Big Thing called Globalization" (Haraway 2016,4) in relation to global environments. It is therefore a concept that is "good to think with" (cf. Levi-Strauss), to define and draw attention to what we are living through. Moore, introducing the concept of Capitalocene, tries to answer the questions raised after the introduction of the Anthropocene focusing the discussion on *which humans* in *which specific history and place* we are talking about, considering "human organizations – like capitalism – as part of nature" (Moore 2017, 1) and strengthening the comprehension of the processes that accelerate humanity's telluric force, generated in a specific time, place, system of power and profit.

Chapter 1: Principle 1 – Observe and Interact: Permaculture, Sardinia and a Passionate Anthropologist

The term permaculture merges three words: permanent, culture, agriculture. It refers to a global movement that encompasses a set of ethics, principles, and design guidelines for creating a sustainable and permanent culture of interaction and integration between humans, non-humans, and the environment (Lockyer and Veteto 2013). This approach was developed by David Holmgren and Bill Mollison in Australia in 1974 and in 1978 *Permaculture One: A Perennial Agricultural System for Human Settlements,* was published. In December 1981 the book received the alternative Nobel Prize from the Right Livelihood Foundation in Stockholm. Permaculture is a holistic approach which has engaged academic interest in the humanities only in the last ten years, but has spread all over the world since the 1980s especially within eco-villages, transition towns and bio-regionalist and de-growth movements.

It proposes a philosophical framework based on taking responsibility for one's actions towards the human and non-human environment (people, other animals, earth, water, vegetation, landscape patterns and microorganisms). This leads directly to the three ethics of "earth care, people care and fair share." If the first two ethics are more

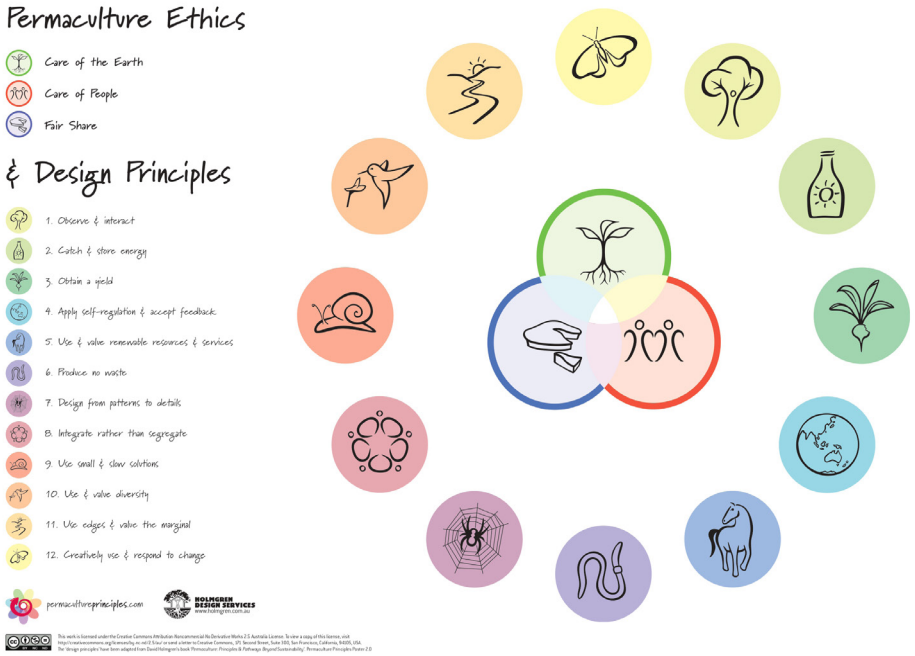

Figure 2. Ethics and principles of permaculture. https://permaculturepriciples.com/resources/free-downloads/#principles-poster

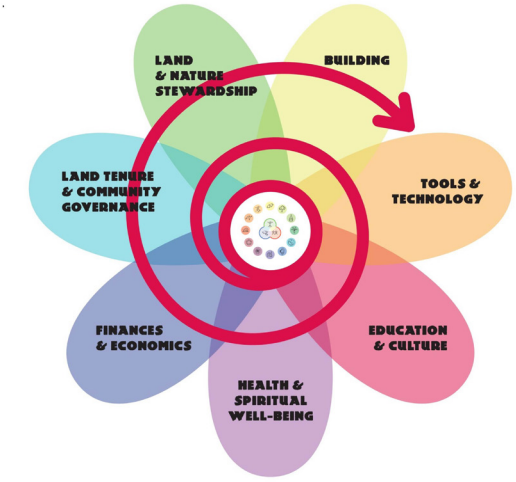

Figure 3. Permaculture flower by David Holgren. At its center are the tree ethics and the 12 principles. Following the spiral arrow, one can see how these drive the designing process in various aspects of life. https://permaculturepriciples.com/resources/free-downloads/#principles-poster

intuitively clear, the third is more controversial; "fair share" between people and other actors in the system means sharing resources but also putting limits to human growth and "nature" consumption, or even better enriching the system with an eye to the future for the third ethic has also been reworked as "design for future generations." Nevertheless, "taking responsibility" for one's actions and "taking care of…," in a permaculture perspective, does not mean that humans are somehow to be considered as the guardians of creation let alone owners of nature. At the same time, permaculture should not be considered a mere theoretical eco-utopic approach; on the contrary, it is deeply practical and open to bottom-up, local actions, as it suggests a set of techniques to be enriched by people's creativity and filled with local meanings. It is necessarily set in the context of, and drawn from, natural patterns and observations where landscapes, winds, water, animals, bacteria and human cultures and practices are all equally historical agents.

In 1985 Mollison standardized the 72-hour course in Permaculture Design. By 1991 the number of graduates had reached 4,000 worldwide, all engaged in some form of environmental and social work (Accademia italiana di permacultura, website). In Italy the Permaculture academy was founded in 2003 by some eco-village activists who had experienced similar schools in other European countries. The role of the Italian academy is mainly to convene two national meetings a year, connect with other European academies and promote a network of trained tutors via a diploma path to becoming a permaculture designer. Basic 72-hour courses are run locally by tutors with specific teacher training. In Sardinia there was an association (SarPa- The Sardinia Permaculture Association) from 2015 to 2022, with local, national, and transnational links. During its active years, the association ran many 72-hour permaculture courses, short introductions to permaculture and collaborations with local associations or municipalities. The association aimed to promote permaculture and advocated a well-established network of people and projects throughout the island. The founding group considered the association as a way to better manage the bureaucracy of 72-hour courses, but most of all as a "social experiment." Indeed, they decided to invest their commitment in developing specific attitudes toward equality among the members, using consensus methods and feedback in every decision process. SarPa decisions had to be approved by the whole assembly and not by a restricted management group. Over the years, the association went from 14 to more than 120 members. Association activities gave birth to a well-established network across the island, promoting strong personal ties between people and assuring help and collaboration with each other. Meetings often gave (and give) an opportunity for celebrating together after work, sharing food and, of course, drinking local wine and beer: as permaculturist like to say: "if it isn't fun, it's not permaculture."

I met some of the members in 2016 during my PhD research, and the more I got to know them and experienced their way of being together, the more I gleaned great stimuli for reflection, as well as points of contact between the anthropological discipline and permaculture. Among all these points of contact, the great value given to relations and interconnections at different levels within a holistic analysis of specific local human and environment systems stimulated the most reflection. I became very

passionate about this and on finishing my PhD, (which was focused on a totally different subject) I decided I wanted to know more about permaculture. In 2019 I started my own 72-hour course with SarPa and deepened my knowledge of the association and its members. The data and testimonies presented here come from these five years of my independent research on Sardinian agro-pastoral traditions renewed and reinvented through permacultural practices. I spent time working together with Sardinian permaculturists, following them to national and regional meetings, taking part in initiatives, as well as participating, as observer or organizer, in three 72-hour courses in addition to mine. I undertook semi-structured and informal interviews (and video interviews) to better understand how the permaculturalists themselves gave meaning to their actions and designed according to the principles of permaculture. I never used questionnaires; structured interviews have not been my systematic method. I preferred semi-structured interviews, participant observation, conversations, co-conducted video narrations of their projects, frequent feedback, and comparison: because of permaculturists' tendency to meta-reflection, it often happened that while working with our hands, conversation fell on meanings and values incorporated in practical actions.

To give just one example: at the end of June 2020, Sara and Sandro,[1] a couple of SarPa members from Oristano, needed to build fences for the rotational grazing of their donkeys. They called friends from the association, organizing a *permatóbiu* to help design and build the fencing. The term *permatóbiu* comes from "permaculture" merged with the word in Sardinian local language *atóbiu* which means "meeting."[2] The *atóbiu* is an intentional, rather than chance, meeting. It is at a perma-meeting where association members meet in order to design actions in their systems of living, to work and think, integrating views and ideas, in a process which also allows time to have fun and celebrate. It is an initiative similar to what is done in the Australian network or in other parts of Italy (especially Sicily) but under other names (called mainly "perma-blitz"). How does it work? If a SarPa member needs help, to design a project or to develop it, he/she can call the network to a meeting (usually one or two days long) where he or she will host people at his/her place. People usually bring something to eat and share. The meeting consists of working sessions where people come and go, some just to say hello to the hosts and celebrate the local food and drinks together. During 2019 six *pematóbius*[3] were organized addressing extremely diverse needs of the members: building a compost toilet, designing a new eco-village, or planting a food forest.

The days before that *permatóbiu* and during the working days at Sandro and Sara's place, I collected some video testimonies I consider of great value. Sandro and Sara agreed to a video interview with me and to make a short video-documentary about their project: "When we need help, we ask, perhaps it is the best way to look for solutions... through the collective intelligence." Sara intervened: "We believe a lot in it!" Sandro continued: "Much of what you see here is a collective work." Sara added:

> …for us the association represents the possibility of giving action to our ideals... we think that change must be enacted, not only thought and idealized, but also acted upon in concrete everyday life... a different lifestyle… (…) we try to understand how

> in the concrete life of all of us, there can be those ideal conditions in which our nature as human beings finds a space... Working together has led us to understand that the transition from the ideal to the concrete is possible, that another system is possible, that another world is possible, that other social and human relationships are possible. For me SarPa is like going back to my origins, to my grandmother's stories. It means to experience what she tells me about her social experience in the town, where everyone had a role, no one was excluded and there was great human solidarity even with all the difficulties of poverty... however, there was a great richness... she tells me that great richness of solidarity is missing now... *s'azudu*! *S'azudu torrau*. Well, she didn't call it *s'azudu torrau* because this expression is used in Campidano and she was from Marmilla, I started recognizing it with the name *s'azudu torrau* with the association.

S'agiúdu (or *s'azudu*, as Sara says, *torrau*) literally means "the returned help," an ancient Sardinian practice often called upon to claim Sardinia's peculiar culture. As Angioni (1982) points out, this type of "returned help" has been sometimes exaggerated and used to claim a particular propensity towards the gift inherent in Sardinian customs. *S'aǧǧdu torrau* (as he calls it in his research), must be historically understood within a complex logic of production exchanges more than within the logic of gift, which instead have episodes of exceptionality; nevertheless this kind of help was established "especially between relatives and friends or, in any case, between people in some way related by kinship...In general, it was a form of exchange in which solidarity relationships played a role...and in each case following the rule of reciprocity" (Angioni 1982, 111–12). Through *s'agiúdu torrau*, a local community member called the others to realize works that are too large to be carried out by one person alone. The help is offered for free without monetary recompense, but the help itself would have to be returned when needed, generating strong social ties sometimes also across generations. Indeed, the help could be returned also by people's children years later. The re-signification of *s'agiúdu torrau* by today's permaculturists, while sometimes assimilating it more to a form of "gift," nevertheless emphasizes its characteristic as a tool for strengthening community ties, a value that, as this contribution aims to highlight, takes on particular importance within the permaculture framework as considered inherent in Sardinian customs. During Sandro and Sara's *permatòbiu*, Antonella (a SarPa member) and I would care for the workers, cooking for all. While cutting tomatoes and stirring the pasta sauce we started reflecting on this practice of the returned help: "*S'agiúdu torrau?*" said Antonella tasting the pasta sauce "... it's a little acid" and then, back to the argument "…they did it always before…I mean, my dad... all the big works at home he did with *s'agiùdu torrau*, it was normal. Now we think it is something new age… ahead of its time… everything that was normal before comes to seem ahead of its time now…or that you have to look for…pretty cool eh! …Hey, the coffee is ready!"

In Sandro and Sara's words it is possible to glimpse what was stated above about the idea of "humans (participating with) nature" as something betrayed, that can be restored by looking back to ancient traditions in a new ethical and practical framework, not a utopia. In their and in Antonella's view, permaculture offered the tools to recall their family history, a tradition re-framed in a shared present time, with the gaze

turned to a fairer future.

In 2022 SarPa members decided to close the "formal" association. They felt the bureaucratic requests of the new Italian third sector regulations were too demanding, to the point that deadlines were stifling the convivial and spontaneous spirit of their meetings. The informal network did not stop after the association closed: people still care about each other and carry on their collaborative networks.

In the next sections I focus on fermentation practices questioning human-microbe relations and the multiple transformative meanings these can assume in the framework of permaculture in Sardinia.

Chapter 2. The Problem is the Solution: Emma's Pets

I met Emma in 2019, during my own permaculture course in Sardinia, and thanks to her I discovered the world of microorganisms. Since then, I started fermenting initially with sourdough and then later with more interest in kombucha and ginger beer, and now have at home an entire room dedicated to fermentation.

Figure 4. Preparing ginger beer at home, as well as lactofermented vegetables and mead. Photography by the author.

About 8 years ago Emma bought an arid piece of land in the countryside outside Cagliari; she is a permaculturist and wanted to start her own project, depending as little as possible on industrial food production, leading a healthier life, working less in order to save her time for human relations and opening her place to people who wanted to learn permaculture. Unfortunately, she quickly discovered that the land she bought was polluted by various buried materials, hard and difficult to work with, and she realized that she lacked the energy and money to reclaim it.

In permaculture it is said that "the problem is the solution." With that perspective, what she considered an obstacle to her project was providing information about her system. There are no bad or good things in "nature," only elements to observe, comprehend and work with. With no money and no energy, she had to look for help and solutions that did not require massive and costly interventions. She started working with what she had: wood chips from brushwood to cover the bare soil, vetiver plants to improve soil hydration, dust, leaves, and microbes. Under the leaves and sticks that lay on the ground a few weeks after pruning her trees she noticed a white powdery substance: a mold that she discovered was a treasure to start getting to work! Mixing it with cooked potatoes and salt, she learned to produce JMS (JDAM[4] microbial solution) a fermented mix of indigenous microorganisms used in organic farming to inoculate the soil. She learned about bacteria and fungi, and with these allies she improved the quality of her soil. Within 2 years she started to eat her own garden vegetables:

> People ask me why I don't have cats or dogs here; I answer that I already have my beloved pets: my bacteria and my mycorrhizal mushrooms! We live here together, I care about them, and they care about my soil, and my soil gives me health.

As Krzywoszynska, Banwart and Blacker suggest "places are socioecological webs of relations that involve soils and their humans, humans and their soils," and

> place-dwelling and place-making nature of human beings points toward the importance of embodied and localized experiences in knowledge production (...) A place-based knowledge of soils starts with the soil-dwellers, and takes their embodied and purposeful activities as a point of departure for developing greater practical and ethical attentiveness to soils. (Krzywoszynska, Banwart and Blacker 2020, 91)

Emma's practical and ethical attentiveness to her soil points directly to a techno-scientific apparatus which is shaped on and shapes social relations and material arrangements, transforming the materiality of existence (Papadopulous 2011, 178-79). Here referring to the theoretical framework of science and technology studies and Puig de la Bellacasa's (2015, 2017) accounts of soil can help to understand the crucial shift from one epistemological approach to another where this "materiality of existence" and politics leads to a different ontology.[5] To understand the shift from epistemology to ontology passing through technical application of science within the permacultural approach, let us go back to Emma working together with soil and bacteria.

She depicts her project as a transformation from a desegregated soil and system to a tight and interconnected intertwining of roots, bacteria, and fungal spores which is actually building a healthier soil, healthier humans, and a place full of beauty. The understanding of "interconnection," in a permaculture perspective, involves something more than the awareness that each action towards the environment produces an effect and feedback. Within the ethical framework of permaculture, taking responsibility for one's actions and taking care also means to evaluate how each action and choice can destroy or increase biodiversity, improve or hinder wildlife at many levels, from a macro-overview to a very micro perspective. For example, it is not necessarily the case that a good intervention in a vegetable garden will produce a bigger harvest, it may reduce the harvest but increase biodiversity and the interrelation between the elements of the system at large. This is considered a fundamental step towards resilience. It marks a turning point: understanding one's actions as a way to promote a complex, interconnected, dynamic coexistence between humans, animals, waters, wind, and other-than-human beings leads directly to a different evaluation of what is soil itself in a world where nature and humans are undivided, bringing about different ways of care. Indeed, as Puig de la Bellacasa points out, "[M]odes of soil care and soil ontologies are intertwined: what is thought of as soil affects the ways in which we care for it, and vice versa" (Puig dela Bellacasa 2015, 2). The circle closes back when considering that different ontologies re-articulate what is an appropriate technique to work within a very different world.

A good example to better clarify this point comes from examining domestic facilities within permaculture practices. Some permaculturists live in self-built homes, totally or almost totally not connected to electrical grid, sewage mains or water distribution systems. Every home system (heating, electricity, or plumbing) is studied and implemented with specific techniques which are deliberately used to sustain an ethical and ideological choice of resistance to a system of consumption and erosion of soil and environment. Compost (or dry) toilets are generally preferred to traditional toilets. This is a toilet where urine and feces must be separated; urine goes into the phytoremediation system and feces into a bucket mixed with sawdust. Using compost toilets, solid excrement is not flushed away with water; it does not have to disappear as soon as possible far from home into the sewage system. Solid excrement is conserved for a few years in its composting caissons, and it is not seen as waste but as a good nutrient source to be reused to feed the soil. Flushing as a practice is considered unethical because it does not adequately account for water as a good; furthermore, mixing urine and feces pollutes a huge amount of water. Excrements become part of an integrated system through the action of microbes over time.

In such an organization, using commercial antibacterial products to clean household surfaces is unimaginable: these would destroy the balanced system of gravel, plants and bacteria once in the phytoremediation tanks, and then polluting the soil too. To clean the home, many permaculturists use homemade soaps or EM ("effective microorganisms"). The latter are strains of probiotic microorganisms, mainly lactobacilli, photosynthetic microorganisms, and yeasts, developed by Teruo Higa, a Japanese agronomist and microbiologist, in 1982. It is a composite of microorgan-

isms, which activates local and native microorganisms, enhancing their natural power of maintaining soil and plants health, thus encouraging more resistance to stressors. Disinfecting a surface destroys all bacteria, both good and pathogenic, leaving free access to the rapid recolonization of the surface by both types of microorganisms. Conversely, cleaning a surface with probiotic bacteria promotes surface colonization by non-pathogenic ones (Caselli et al. 2019). Moreover, probiotic cleaning products, once in the phytoremediation tanks, will even improve water, soil, and plant health. EM can be used to clean but also to germinate seeds or inoculate the soil through irrigation to process nutrients and make them more available for plants. Indeed, in many permaculture projects food for humans and animals, as well as soil compounds, are often prepared through fermentation. The cycling of bacteria, fungi and yeasts is completed through the composting of excrement, which once transformed into soil returns to the land that produces food for people and animals. In such a framework, microbes, fungi and yeasts are pivotal: without them no regenerative agriculture or compost would be possible, nor a "healthy" biodiverse system. Bacteria then are more connected with the idea of health than disease. I first tasted Kombucha (a fermented tea drink) at Emma's place and discovered that some foods can be "dead" and others "alive." The idea of "alive or dead" food (or compounds) comes from Emma's descriptions as well as from some fermentation workshops where I assisted during permaculture festivals. Products within large-scale food production for which durability is guaranteed through processes such as pasteurization were considered "dead," devoid of bacterial life. A living product, on the contrary, changes and transforms due to the presence of living bacteria. In these narratives, the idea seems to emerge that a living food is the product of an involvement of reciprocal care between a person, bacteria, soil, and raw materials; at the same time, alive foods and compounds seem to transfer their positive vitality to whoever consumes them. To give a quick example: Adelmo is a permaculturist in Sardinia, an expert in home construction with natural materials, and a permaculture tutor and teacher.[6] During a conversation with him, speaking about what makes a healthy integrated home system, he said ironically but with a hint of seriousness that the cycling of good bacteria for composting requires good quality feces and therefore a good diet. It is not possible here to go deeper into this circular relationship of "vitality and health" through bacteria care, even though this could be an interesting topic for future reflections.

After becoming acquainted with Kombucha at Emma's place, I started my fermentation adventure, even without a compost toilet to improve the soil in my little town garden where I lived at the time.

In the next section I will delve further into food fermentation, reflecting on how the very microscopic observation of microorganisms can offer a model for advocating relatedness also within human communities. Indeed, following the permaculture principle "design from patterns to details" of which the underlying idea is that we must learn from and with nature, symbiotic colonies of microorganisms offer an organization that is "good to think with" (cf. Levi-Strauss) for better understanding what I will call here "a new ontology of relations."

Chapter 3. Designing from Patterns to Details: Making kin with Our Tiny Companion Species

In July 2023 I was invited to hold a fermentation workshop during a permaculture course, which greatly improved my understanding of the intersection between permaculture and human-microbial relationships: both the process of preparing the workshop together with permaculturists and the conversations with the students were illuminating. They are the driving force behind the following reflections.

On a terribly sultry summer day, a group of permaculture students and I tried to survive the heat by drinking ginger beer and talking about microbes. As the workshop started, a student asked if it wasn't dangerous to "play with microbes" and someone else quickly replied, "adding salt or brine to vegetables is like having a very good bouncer at the door of your nightclub, it only allows good bacteria to enter, and keeps pathogenic ones away, so that the party for our palate is fantastic." We reflected on how humans have fermented since ancient times, to the point that our taste and bacteria have domesticated each other, evolving together. "Our relations with the bacteria that are responsible for the various types of fermentation can be thought of alongside those we have with dogs, cats, sheep or cows" said someone else, only slightly ironically. In fact, the change of perspective proposed by permaculture is not about understanding what is "out there in the environment" as an unambiguous "matter of fact", but as emerging from a dense network of interconnections. Thinking upon and knowing "nature" means to "care about" it in the way Puig de La Bellacasa suggests: "Relations of thinking and knowing require care and affect how we care" (2017, 69). Tom, an anthropologist by training and now a small-scale farmer, conducted the workshop with me; he used this joke to invite students to delve deeper into this co-evolution and reciprocal domestication. He invited students to think from a very micro-perspective, imagining microbes as "tiny elements of care" (Puig de La Bellacasa 2017); just like us, cats, or cows, what do they need to feel good and prosper? They need food, a healthy environment, and the opportunity to interact. We need to give them food: amino acids, proteins or sugar and they will eat and digest. By doing this, they increase the bioavailability of nutrients, decrease or eliminate cooking times, and produce carbon dioxide, acetic acid, or alcohol, which is what we are looking for in our diet (or to regenerate the soil). We can design a permaculture project, he suggested, with this micro scale in our minds as a model: observing the needs of each element and its outputs we can better understand how to maximize its role in the whole system, and we can promote biodiversity and resilience also in a more macro scale such as the one of our homes or our local communities.

Permaculture offers a tool for "budgeting" the costs and benefits of different elements in a system and maximizing efficiency of design: functional analysis. In a functional analysis every element within a system is understood in all its/her/his properties, considered (and, in a design project, located) following the rule of connecting as many different elements' inputs and outputs within the system as possible (what it/she/he needs and what it/she/he offers to the system), with the intention of maximizing efficiency and resilience.

Figure 5. Explaining functional analysis during a PDC. Photograph by the author.

The stress is on connections; the more an element is connected to others and its functions are increasingly redundant at a system level, the greater the system's resilience. Any element is connected through its inputs (what it needs) and its outputs (what it produces), the inputs of one are provided by the outputs of another. In such a perspective there is no waste, what is the result of one's process is a resource for the other. Any permaculture project must be guided by functional analysis and aims for the functional redundancy of singular elements through the multiplication of interconnections.

The Kombucha SCOBY offers a very good example of this mechanism on the micro scale. The term "SCOBY" stands for Symbiotic Culture Of Bacteria and Yeast: once added to a sweetened liquid the Scoby yeast consumes sugars and produces ethanol and carbon dioxide. Then acetobacters oxidize the ethanol into acetic acid thanks to the oxygen present in the environment (Zilber and Redzepi 2018). If only one of these elements fails to interact with the others, the magic of the drink we love is not produced. Starting from this example, during our workshop Tom recalled the permaculture principles: observe how nature works, identify a natural pattern, and reproduce it in designing your project's details: this helps it act with nature and not against it. I

continued after Tom: "If you set the table well for microorganisms (as David Zilber says), they will prosper and multiplicate, and you will definitely need a good network of friends to share the surplus of Scoby, kefir grains, and ferments. It is an output which strengthens connection, I know exactly where my Scoby comes from, it carries the story of my relations with people." (see also **Pétursson and Sturludóttir in this volume**)

Some in the group already had some experience with lactofermentation or with kombucha production, while others didn't, so we began discussing each other's techniques in the various fermentations: how many grams of tea per liter? How many grams of sugar? How many days? What temperature? The setting helped: in those days, with the temperature at thirty-eight degrees Celsius night and day, how could I give a fixed number of days for the kombucha to be ready? Clearly, it is different fermenting in winter than in summer. How can we be sure that our dear microorganisms have enough to eat, if the room temperature is optimal to promote quick interactions and exchanges between the *saccharomyces cerevisiae* yeast and acetobacter? There are many energy flows and limiting factors to keep account of during a design process. As much as permaculture suggests to "observe and interact" (principle one) when designing a garden, at the same time we have to find a way to observe and interact with our fermenting microbes. While your pets intensely stare at you when they're hungry or cold, with microbes it's a little more complicated. It's a mutually beneficial relationship, but one of you needs a little work to make both of you happy. This is the task of the fermenter (Zilber and Redzepi 2018). Indeed, to produce good, fermented food it is important to carefully balance precision, care for ingredients and develop a "personal" relationship with the micro-organisms mediated by all the senses. How do they smell? How do they look? How much are they making the airlock bubble? Many books on fermentation suggest that the main way to understand if a jar of lactofermented vegetables is ready is to taste, taste, taste! (See also **Veera Kinnunen in this volume**).

During the workshop I confessed that in my own experience some communities of microorganism seemed to me "nice and tolerant" while others "overbearing and demanding." For example, I tried water kefir grains, but I quickly stopped working with them. They were too needy of *my care* and the product must be consumed quickly to maintain its taste and not explode in the bottle due to the carbon dioxide pressure. In my hectic life, I have developed a lasting relationship of "mutual understanding" with bacterial colonies more willing to tolerate my forgetfulness, my lack of time, and my need to safely preserve the fermentation product in the fridge for even a month: kombucha fits better with my lifestyle. However, for each student it was different, some did not agree with me because their specific relation in their specific space of interaction was different. Colonies of bacteria in a kombucha Scoby can also vary depending on where it comes from (even if the main two elements are usually saccharomyces cerevisiae yeast and acetobacter). Stimulated by the idea of being part of a complex set of human-microbes' relationships that can modify the structure and taste of a product, another student said: "More than fifty percent of our body is composed of microbes, if you really think about that you can understand that the limits of self and not self

are so blurred." Indeed, the focus on microbes leads to considering each one's body as more than a single and defined unit, but rather as the result of multiple interactions that make up the very nature of the human.

Roberta Raffaetà conducted ethnographic research in the Segata lab, a laboratory of metagenomics at the *Center for Integrative Biology* in Trento, Italy. She analyzes the ways in which microbes became real social actors through meta-genomic findings. She urges reflection to consider identity itself as the result of interactions mediated by microbes:

> Microbes are part of our very identity as humans. The composition and activity of microbes are central aspects for carrying out multiple processes involving health such as metabolism, weight regulation, the activity of the immune system, allergic reactions, reactions to stress and the success of therapies, they even influence mood and personality. [...] The interactions we establish with other humans and non-human beings shape and change our microbes […]. Instead of describing health as the property of a single organism's immune system working to stop and kill invading enemies, we are in the era when [microbes] are considered necessary for our health. (Raffaetà 2020, 29)

In other words, our health and our identity as humans is not simply a characteristic of the individual, but something that is created in the complex relations between people, environment, and microbes that co-evolves and co-constructs our experience of "being in the world."

What permaculture invites us to do as a preliminary operation to design actions is to think with complexity, look at the system and disarticulate human centrality. Therefore, bacteria and fermentation offered a great opportunity to rethink ourselves, our health, our social networks, our experiences, our life environment. Including microbes in permaculture projects means considering humans as a dynamic ecosystem with permeable boundaries, merging with the microbiome of the earth, of the vegetable garden and of the animals that coexist in the same system: if the soil is ill and dead without microbes, food will also be "dead" and produces unhealthy people unable to take care of the soil. The logical consequence is to consider as equally valuable the well-being of animals, plants, soil, water, micro-organisms, and humans. Microbes not only have a role as partners and co-builders of the system but circulate creating connections between elements. "My hens, my apples, my soil, and me, we share the same, local, microbiome." Said one of the teachers during my permaculture course at Emma's place.

From this perspective it is almost self-evident that to produce good, fermented food, one needs organic vegetables, because chemical products even on the peel could kill or alter the product's micro-biota. It is even better if you grow them yourself, which is doubly valuable because locally grown vegetables will share with you the same native, well-cared-for, healthy, biodiverse, and domesticated indigenous bacteria.

Students in the workshop reflected on how, in order to produce good food and enough surplus to store for months through fermentation, it is important to "care for

the earth" (first permaculture ethic), which enables the production of healthy food for "people care" (second permaculture ethic), in turn enabling "fair share" (third permaculture ethic) with people, but also fair sharing of the environment with our tiny companion species (Haraway 2008).

In this section, thanks to the reflections that emerged during a 72-hour permaculture course, I pointed out how fermenting food can assume a specific meaning if understood as starting from the ethics and principles of permaculture: microbes blur the boundaries of the self, enabling a more global vision, dis-articulating human centrality to advocate for shifting attention to what happens in the processes in-between the single elements, in-between the web of meanings woven in an inter-species story (Tsing et al, 2019; Haraway 2019), where microbes and humans have domesticated each other. In the final section I try to bridge the micro vision with a broader socio-political one based in Sardinia.

Chapter 4. Eating is an Agricultural Act: Resistance, Resilience, and the Fermentation Revolution

There is a close link between historical events, relations of agricultural production and hegemonic/subaltern classes in Sardinia; that is to say, there is a complex relation between the bucolic imagery of the countryside with Sardinian shepherds and peasants as industrious, pious, respectful, proud, and natural; the metahistorical mythologizing of the "albeit genuine feeling of otherness" (Angioni 1982, 15) of Sardinians and the idea that "the bad were and are always people from outside!" (ibid.). Even nowadays it is common among Sardinians to portray Sardinia as suffering from the Italian mainland's extractive attitude towards the island. This idea is supported by historical facts, described also in both popular and scientific texts. It is not possible here to delve adequately into the historical and cultural dimensions of this phenomenon, as well as the mechanisms that led and lead to a certain mystification of historical events. For an analysis of this issue, it is worth referring to Angioni's contributions (Angioni 1982, 1986, 2000 and 2003). For the purposes of this discussion, however, it is useful to mention the historical moments that marked a rupture between environmental conditions, technical means and knowledge, and the social devices that enable and organize it (the social relations of production) (Angioni 1986,148). These historical events were the introduction of a feudal system with the Aragonese conquest and, during the Savoy administration, its abolition. These "marked the crisis of civil society in the last seven centuries of Sardinian history, as well as for the history of Europe in general, but experienced here in a manner more similar to that which was characteristic of the countries colonized by European powers: in both cases there is a traumatic change imposed from the outside mainly to favor external interests" (Angioni 1982, 75). In particular, the Savoy of Piemonte administration period from the 1720s until the unification of Italy in 1861 is often cited in people's conversations as a symbol of the damage suffered by the island, especially the 1800s when Sardinia was deforested to satisfy the kingdom's need for building materials. On this issue *Colpi di scure e sensi di colpa* [*Hatchet strokes and guilt*]) by Caterini (which also inspired a documentary *Àrbores* –

una storia dimeticata [*Àrbores – A Forgotten Story*]) had a certain resonance within the permaculturists network, formal and informal ecological groups and independence-based movements. It was during the same period of Savoy administration that the feudal system was dismantled. In 1820 a law was enacted: *l'editto delle chiudende* ("The Edict of Enclosures") which gradually dismantled the traditional practice of using unfenced lands near towns as common lands for the local community's cultivation and grazing (defined with the word *ademprivi*). Many Sardinians perceived these fenced lands, that were no longer available for common usage (but used by large landowners, often originally from the mainland), as "stolen" from locals in favor of private outsiders' interests. In some understandings of the historical events, this theft goes along with the loss of ancient agro-pastoral practices of sharing, with the impoverishment of communities, the depopulation of rural areas, soil erosion and pollution due to industrial monocultures (Parascandolo 2016). During the 2019 festival of Mediterranean Permaculture organized by permaculturists in Sardinia, professor Parascandolo from the University of Cagliari was invited to present his and Maurizio Fadda's book *Il nostro cibo – per la sovranità alimentare della sardegna* (*Our Food – For the Food Sovereignty of Sardinia*): a passionate manifesto on the importance of local food production, advocating small farms and urban gardens as a way to regenerate an environment depleted by massive global monoculture holdings, and showing how, along with the loss of ancient practices and common lands, the local social context was also lost. The discourse on island food sovereignty (Parascandolo and De Meo, 2020) takes strong roots in post-colonial identity discourses: on several websites and blogs advocating for the region's independence it is denounced that more of 80% of food consumed on the island comes from across the Mediterranean Sea, although the Sardinian economy is traditionally based on agriculture and livestock.

In a framework where "people care, earth care and fair share" are considered the basic ethics for designing, the commitment to having more power and control over the quality of food production and distribution is broadly shared. Indeed, if humans and human communities are part of an integrated system, if each element gives to and takes from the system contributing to its overall health, if everyone must take responsibility for his or her actions, then actions are evaluated by the consequences that they produce on the set of interconnections and the context's resilience. In the specific case of permaculture in Sardinia this seems to assume deeper meanings than a general attitude of conscious consumption because of the aforementioned issues: the value of "relatedness" incorporated into any permaculture project but also the importance given to local traditions.

In the first section I mentioned *s'agiúdu torrau* as a restored and re-invented tradition. It is now useful to illustrate a further way in which agro-pastoral traditions and permaculture intertwine. Another ancient attitude still deeply felt is that of hospitality. Sardinian hospitality is used both in tourist advertising and in identity discourse. A vast amount of literature has been produced on Sardinian identity. In this context, Gino Satta analyses how tradition and identity discourses are performed by the tourism industry and offers an interesting compendium of hospitality practices on the island. Welcoming "the other" who enters the home, the "stranger," whether from

Figure 6. Maurizio Fadda, co-author of the book *Our Food - For the Food Sovereignty of Sardinia*. During a Permaculture course in 2023. He held a lesson on the importance of preserving local and ancient varieties of seeds and hand threshing. On the t-shirt: "Eating is an agricultural act." Photograph by the author.

another nation, region, town, or household, involves offering food to either consume together or to take home. This is a widespread practice throughout the Mediterranean, rooted in Greek and Roman culture, whose presence is still strong in Sardinia. *Su cumbidu*, "the invitation," consists of "offers of symbolic goods that take place according to a precise etiquette when a stranger comes to visit one's home or between fellow villagers in public spaces" (Satta 2001, 167) The attitude is so strongly felt and widespread that the use of the Italian term *invito* ("invitation") also changes. It is common in Sardinia (not only using the local regional language, but also in Italian) to use the expression "I invite you a coffee" (*ti invito un caffè*), instead of "I'll offer you a coffee/I invite you for a coffee" (*ti offro un caffè*/*ti invito per un caffè*): the thing offered as a hospitality invitation and the invitation itself merge in a single concept. Cosimo Zene worked on gift-giving in central Sardinia and the customary law of vendetta. Referring to a specific kind of gift ("the [...] *imbiatu* to define a system which refers to the mutual 'sharing' of food" (Zene 2007, 293)) he says:

> this system is meant to strengthen not only ties of cooperation and solidarity amongst the villagers but also to maintain a way of life and of 'being', which refers to group and community identity. This is very close to what Mauss defines as 'total social fact' or 'prestation totale', because it both concerns groups of peoples as opposed to individuals and touches upon so many aspects of social life. (ibid.)

As with the gifts analyzed in Marcel Mauss' famous essay (1923–24), the gift given binds the parties in a social relationship that continues over time a mutual interaction through giving and taking: "*Si cheres chi s'amore si mantenzat, prattu chi andet, prattu chi benzat*" – "if you want love to endure, for every plate that leaves, let a plate return" (Gallini 1973, 60). It is not possible to go deeper into the many shapes and meanings gift and gift economy assume on the Island, but we can touch upon the exchange of gifts as a political ethical practice among permaculturists.

In the second chapter I mentioned Adelmo, a permaculturist and teacher. Adelmo lived for a while in a camper van. He once told me that he found himself troubled entering friends' homes: "In Sardinia it is customary to enter people's homes by knocking with your feet" he said. Knocking with feet means that your hands are not free, they are busy with things to share, almost always food or drink. "Living mobile, I have

Figure 7. Seed exchange during the 2023 PDC. Photograph by the author.

no homegrown food to share, so I often stop over in their homes and exchange what I have, my ability to make" (Adelmo, conversation May 2021).

Therefore, when I started visiting friends too, knocking on their front doors with my feet, instead of having my hands busy with industrial products, I preferred carrying my own products. Because I did not have a farm and my bread did not taste that

good yet, I used to share ginger beer and kombucha. Someone even renamed me as "Miss Ginger." I always left friends' homes with my hands fuller than when I arrived, full of seeds or of vegetables to improve my fermentations. My vegetable garden had to grow to host the many new varieties and my skills in fermentation grew along with my friendship ties.

So far, it is possible to understand the practices of fermentation among permaculturists in Sardinia as an oriented action of resistance to a system of consumption and erosion of soil (and human relations), as a strategy to take back the power from the big agro economy (and from external interests) and oriented towards a different care of soil, land and life; all this seems to pass through the reference to precise Sardinian traditions.

Conclusions

Throughout this article I have investigated fermentation among permaculturists in Sardinia by assessing how their practices incorporate values and a precise interpretation of the island's history, land ownership and the economic system of food production, but most of all how permaculture fosters a different way of perceiving the world: from micro to macro scales and back, following a meshwork of relationships between human and other-than-human beings. In this framework people are understood not as individuals but as micro-biomes consistent with their environment, each element somehow seen as a symbiotic colony of microorganisms. This makes boundaries between "nature" and humans less clear-cut, unhinging the centrality of the human in the ecosystem and means that to strengthen the whole system it is necessary to take care of each element. Indeed, in permaculture the functional analysis and the high value accorded to relations and interconnection, the awareness of being mainly a system and not an individual, are applied also in human network relations, fostering a different way of balancing costs and benefits in actions and design choices.

Permaculturists in Sardinia, in the exchange of "cared-for" fermented foods, seem to incorporate local traditions of gifting and mutual help. Food fermentation can thus be understood as politically situated in a discourse of resistance, a day-to-day revolution. Indeed, as Raffaetà points out, "the governance of bodies is mediated by the regulation of microbes" (Raffaetà 2020, 35), therefore caring about local microbial biodiversity when growing and fermenting fruits and vegetables seems to incorporate the desire to have more power over bodies and relations: "dissent over how to live with microorganisms reflects disagreement about how humans ought to live with one another" (Paxson, 2014, 115). In this perspective, growing vegetables for human nutrition, transforming the surplus and conserving it for several months to ensure good nutrition and the possibility of sharing healthy and "alive" food, seems to reinforce the politically-oriented actions linked to the three ethics, a conscious and shared reflection on how humans can live together and share their world with their "tiny companion species" (Haraway 2008).

At the very beginning of Gibson-Graham, Cameron, and Healy's work *Take Back the Economy: An Ethical Guide for Transforming Our Communities* (2013) the authors

state: "Our economy is the outcome of the decisions we make and the actions we take" (xiii), adding that "ethical action is a practice of adopting new habits—habits of reflecting on our interconnections with others, approaching the new with an inquiring mind and an appreciative stance, trusting others as we jointly encounter a future of unknowns and uncertainties, and learning to allay our fears and conjure creativity" (xviii). Through fermentation the people I met are performing a diverse economy through ethical actions (Roelvink et al. 2015): small, everyday actions such as eating, excreting, exchanging gifts or creatively co-operating with microbes to regenerate the soil. One of the predominant tenets of modern economics is growth; ethnographic data suggests that the difference in permaculturalists' performed diverse economy does not have to do with the idea of growth, but rather with what has to grow through exchanges. Using functional analysis to balance the system's inputs and outputs of energy, growth means enhancing the number of interconnections and elements linked to one another, from the microscopic to humans and up to wind and rainfall, with the aim of promoting abundance of fruits and interconnections, limiting the erosion of soil and relations, and ultimately working towards a different world and a future of wealth for the planet.

In an everyday context and at the most practical level they seem to challenge the concept of "Capitalocene" proposed by Moore (2015). Indeed, Moore suggests, exactly like that of unpaid labor in Marxist theory, a capitalistic approach to nature requires to look for "unpaid nature." He calls this the "law of cheap nature" for commodity production. Food and raw materials are two of the four basic "cheap nature" categories. Functional analysis seems to offer a tool for budgeting "value" differently. Permaculturists' actions are not driven by mere criticism of capitalism but are ontologically based in a different "economical balance" following a different "law of value" (Moore 2015) in designing their projects: not the law of cheap nature but the "law of relatedness."

We can imagine the category of relatedness as something more than the connection of humans and their socio-cultural norms; we can imagine the possibility of being part of a broader system of elements, each giving something to, and taking from, the complex of rules and interactions, generating a new, alternative ontology. It is a concept close to the "making of kin" advocated by Haraway (2015) in an intentional community of reciprocal care and response-ability (including humans, non-humans, other-than-humans, the inhuman). It is important to equip ourselves with theoretical categories to name and understand our transformative power over systems we live in, but it is equally important to develop tools to guide, comprehend and budget actions, practices and choices in a different economic and political frame. All this is to suggest that Sardinian permaculturists are experimenting with a different "economic balance" to act and interact, rooted in a specific tradition context. Maybe Sardinian permaculturists' practices are putting to work tools, such as functional analysis and the "law of relatedness," to promote a new way of valuing interactions, reciprocal exchange and, finally, of generating alternative-cenes beyond the Capitalocene.

With this consideration, my research on fermentation practices among permaculturists in Sardinia has tried to offer an entry point to some questions, but may also

open up to further research: how does this specific kind of "ecotopia" (Lockyer and Veteto, 2013) materialize in daily actions? Which principles guide the choices of people who recognize themselves within the philosophical framework of permaculture, and how do these allow them to move from the level of ethics to that of practice, and vice versa? How can local agro-pastoral traditions be renewed (and maybe also undermined) looking for a fairer future for human and other-than-human beings sharing the planet? Are permaculturists' practices in Sardinia performing a diverse economy, following a different "economic balance" of their actions in designing interaction between humans, non-humans, and environment? Are we witnessing an experiment of a "new ontological politics" through setting the table for microbes?

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Notes

1 Apart from Tom Rodgers (his real name), people's names have been changed to anonymize them.

2 In Sardinia, local languages (not dialects) are used. They are considered an important part of regional culture. There are many variations depending on the area. The words used here are common to many variations, although the accent and spelling may vary. Here I chose Campidanese because the activities presented were held in an area where Campidanese is spoken.

3 The plural for the word *atòbiu* in Campidanese is *atòbius* while in Logudurese it is *atobios*—here I use the Logudorese variant.

4 JADAM is a group of organic farmers established in South Korea in 1991 by Youngsang Cho. https://en.jadam.kr/com/com-1.html

5 It would stretch the limits of this article to delve further into reflections on permaculture practices, starting from Puig de la Bellacasa's contributions on soil and on technoscience's objects of study as "matters of care" (e.g. Puig de la Bellacasa 2015, 2011), towards Papadopoulos's reflections on alter-ontological politics and regions of objectivities (Papadopoulos 2011).

6 A permaculture tutor is a certified permaculture designer who follows the "*active learning path*" of a future permaculture designer, after the 72 basic course. A teacher is a certified permaculture designer with an advanced diploma in teaching.

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Smell as Transspecial Correspondence

Veera Kinnunen
University of Oulu
Finland

Abstract

Veera Kinnunen conceptualizes smell as a form of transspecial correspondence by drawing from her fieldwork among bokashi composting community in Finland. Bokashi is a method of handling organic waste through fermenting, which has gained popularity in the global North. Kinnunen argues that the sense of smell becomes the most important sensory modality for engaging with waste and reaching out to the invisible microbial communities "working" in the fermenting matter. Through the example of an alternative waste practice, the article illustrates how different practices may change the way practitioners relate with abjected matters, and make space for new metabolic imaginations.

Keywords: bokashi; smell; olfactory knowing; transspecial; correspondence

Yesterday, I had a most unsettling encounter with my organic waste that had been cumulating mass but also, as it turned out, life, during an exceptionally warm summer week. I had experimented with collecting my compostables into a stainless-steel container for a temporary pre-fermentation before moving it into the sealed fermentation bucket. Apparently, the temporary container had not been as airtight as I had supposed, and as a result, the organic material had gone putrid. The very moment I was studying the container, my younger child aimlessly wandered to the kitchen. He was struck by a stench strong enough to tranquilize a medium-sized elephant. His body reacted immediately: gagging and yelling, he stumbled away from the kitchen, not knowing what it was that had hit him.

My son reacted as if our waste bucket was giving him a warning: "Do not enter, do not touch me." However, in me, having taken care of the batch and thus having created emotional strings to it, the same smell generated somewhat mixed responses and interpretations. For me, the smell was not only a warning but also a cry for help. An extremely loud cry for help. I was tempted to dump the whole batch into the rubbish bin, but I felt responsible for its current monstrous state, as it had been a result of my foolish experimentation.

From previous experience, I knew how I could stabilize the situation and (re)start the fermentation process. Breathing through my mouth, I poured the stinky, slushy matter into an empty bokashi bucket, threw in a few handfuls of bokashi bran, and at a whim, sprinkled some biochar on top of it all. Now, writing this the next morning, I haven't yet dared to have a peak in the container. I will let it brew for a while, and time will show whether I have managed to save the batch from decay back to healthy fermentation.

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Tuning in to Smelly Stories

This unsettling encounter with a putrid organic material was an extreme example of olfactory exchanges between me and my waste. However, similar, albeit typically less disturbing engagements have taken place on a daily basis since I started to experiment with *bokashi*: a method of composting kitchen waste with the help of fermentation based on a consortium of microbes. I have learned that my bokashi is happy and contained, when it smells faintly of lemon and vinegar, and when it is suffering and in need of assistance, it begins to smell disgusting, resembling vomit or pig manure.

My and my fellow bokashi practitioners' eagerness to tune into the well-being of our kitchen wastes by sniffing their quirky aromas, is not a common way of relating with waste in a Western, urban setting.[1] A more familiar set of action would be getting rid of anything with even the slightest potential of smelling—let alone developing uncontrolled microbial life—from the household as quickly as possible. Therefore, I am not exaggerating when I argue that bokashi composting radically alters urban relations with so-called waste. Adopting bokashi practice into urban everyday life demands acknowledging and even welcoming the murky presence of neglected things (Puig de la Bellacasa 2017) such as waste materials, microbes, smells, and other unruly elements that have typically been carefully kept away from the modern landscape.[2]

In this paper, my focus is on corporeal engagements with organic waste material in bokashi practice. Drawing from more-than-human and multispecies approaches (Ogden, Hall and Tanita 2013; van Dooren, Kirksey and Münster 2016), I understand organic waste here as itself an active and unruly entity consisting of many materialities, and teeming with life (Hird 2013). Through empirical observations from bokashi practice, I explore how the lively materiality of waste is carefully attuned to in a multisensory register and examine how these engagements become narrated as reciprocal communication.

In what follows, I seek to explore beyond human-exceptionalist notion of language and communication, and wonder, how we could acknowledge and tune into other-than-human modes of storytelling (see also Thompson 2019). By focusing on olfactory engagements within bokashi composting, I explore whether smell could help imagine and story non-lingual modalities of transspecial communication. In the spirit of feminist, multispecies speculation, I ask what kinds of worlds may be storied when what and how we smell is taken seriously.

This article proceeds in three sections. First, I set the stage by introducing the mode of multispecies storytelling and the theoretical voices that I join when narrating this story. Second, I shortly introduce bokashi composting as a method, and describe how I have approached it as a researcher and a bokashi practitioner. In the third section, I delve into exploring olfactory engagements with bokashi more closely. The discussion includes smelling as a neglected mode of knowing and then continues to stories of microbial collaborations. From these stories, I further speculate olfactory engagements as a mode of communicating and negotiating with microbial communities. I conclude by provoking that cultivating sensory sensibilities to attune to microbial stories matters.

Multispecies Storytelling

In seeking to tell different stories, I join the lineage of feminist thinkers who emphasize the power of stories and imaginations in aspiring for a different, more just, future. According to radical feminist imaginaries, "how we think and speak the world, shapes how we act in it and make it" (Hamilton and Neimanis 2018, 524). In the face of ever-deepening and multiplying crises, human-centric ontologies and epistemologies are falling short in their responses. The need the re-imagine who we count as "us" is becoming ever more urgent in the face of the multiple crises, linked to ongoing environmental emergency. As Ida Bencke and Jörgen Brunn (2022) formulate, it is important to nourish and share other kinds of stories that may hold promises of modest yet radical hope. As scholars, we need to ask ourselves what kinds of political, cultural, aesthetic, and scientific prejudices police our speculative abilities to think and act differently, and how we can break with the stories that justify this policing (Bencke and Bruhn 2022, 10). Answering this ethicopolitical and epistemological challenge, Bencke and Brunn (2022, eds.) propose multispecies, intermedial storytelling practices that aim to "represent, relay, and read" worlds differently by taking other species seriously as protagonists in their own right. In their words, multispecies storytelling steers attention to signals, traces, and voices of other beings as valid modes of communication. They ask: "What if we, instead of telling story upon story about nature, were to engage in collaborative storytelling activities with that humming, throbbing murmur of countless critters that all, collectively, make up 'our' world?" (Bencke and Brunn 2022, 10.) Folklorist Tok Thompson (2019) has pushed the provocation even further, and asked if communication is understood as a more-than-just-human matter, shouldn't cultures, traditions, and heritages then also be approached as interspecies relations. This provocation becomes complicated, when attention is steered to cultures of cultures, microbial communities whose ways of being in the world differ radically from those of humans'. In social sciences and humanities, human-non-human communication has typically been theorized through communicating with animals, such as horses (Argent 2022), rats (DeAngelo 2023), primates or birds (Plec 2013), with which communication tends to take place through bodily movements, touches, sounds, and signs (Colombino and Bruckner 2023). Decentering the animal kingdom and turning attention from charismatic animals to plants, fungi, or lichens, the issue of multispecies communication tends to take a more speculative or even fabulist turn (see e.g. Haraway 2016; Höckert 2020; Höckert, Rantala, and Jóhannesson 2022; Rantala and Höckert 2024). To give but one example, my colleagues Outi Rantala and Emily Höckert (2024) have inquired, how listening to the stories of tiny creatures such as mosses and lichen might mobilize curiosity and responsibility towards supposedly insignificant and inanimate beings. They take multispecies storytelling as a methodological tool that enables recognizing non-human agency and cultivates sensitive approaches to otherness (Rantala and Höckert 2024, 64). Multispecies storytelling, then, provides a means to attune to the modes of communicating of less visible and charismatic, yet omnipresent messmates (Haraway 2008; Höckert, Rantala, and Jóhannesson 2022; Rantala and Höckert 2024).

In feminist environmental theories, composts have often been taken as a metaphor for speculating the messy modes of becoming and thinking together with non-human others (Abrahamsson and Bertoni 2014; Hamilton and Neimanis 2018). In contrast to the dominant Western narrative traditions that emphasize linearity, meaning and rationality, composts have stood for approaches based on heterogeneity, impurity, and open-endedness (Bencke and Bruhn 2022; Hamilton and Neimanis 2018; Hohti and Tammi 2023). Donna Haraway, for instance, frequently describes the material-discursive processes of "worlding" through a compost. In compost, as in life, "critters are at stake in each other in every mixing and turning of the terran compost pile" (Haraway 2016, 97). Drawing on Haraway's thoughts, multispecies scholars Riikka Hohti and Tuure Tammi (2023) have developed a method of *composting storytelling practice* as a way of becoming attentive to complex "worldings" and being open to new concepts, stories, protagonists and storytellers. Hohti and Tammi emphasize that this kind of storytelling practice has a dual capacity to focus on situated detail but also to open up to disordered margins and "unruly edges" (Hohti and Tammi 2023; Tsing 2021; Rantala and Höckert 2024).

Drawing from these openings, I engage in multispecies storytelling practice, but instead of understanding compost as a metaphor, I engage with the physical, visceral composts. If telling different stories changes how we shape the world, and what kinds of futures we aspire to, then these composting stories are also political by highlighting how and why the mundane and neglected matters must be paid attention to – and showing how it might be done. To attune to the stories of and with composts, I seek guidance from Anna Tsing's (2016) strategy to "listen politically" in order "to detect the traces of not-yet-articulated common agendas." By asking, what kinds of worlds may be storied when what and how we smell is taken seriously, I turn the method of listening politically into a speculative form of "sniffing politically."

Methods and Data—and What is Bokashi?

Before I delve deeper into composting storytelling, I shortly introduce bokashi to readers unfamiliar with the method. Bokashi—also known as urban composting—is a method of dealing with everyday kitchen waste by fermenting. Finnish Bokashi beginner's guide describes the method with these encouraging lines:

> This might feel strange at first, but is quite simple after all. Throw organic wastes in the bucket, add some bran on top of it, and close the lid. When the bucket is full, let it stay sealed for two weeks, after that it's ready to be turned into soil. The waste then turns into soil in two weeks. It's Bokashi! (Bokashi, the beginners guide)[3]

Bokashi is a mix of modern microbiology and various Asian traditions of utilizing indigenous microbes in farming. The commercial, laboratory-produced consortium of microbes commonly used in modern bokashi-making (consisting mainly of lactic acid bacteria, yeasts, and purple bacteria) was developed in Japan already in the 1980´s,

but the method has only recently been introduced to the Western world. Bokashi has been developed specifically to suit urban ways of life: the process is relatively simple, cheap, does not require a lot of space, and can be proceeded completely indoors. The method is almost as simple as the beginner's guide asserts. Therefore, the method has been quickly adopted into the lives of contemporary urbanites seeking to lead more ecological and healthy lives.

I have been immersed in the bokashi community since the method arrived in Finland almost a decade ago. Since 2016 and up to date, I have conducted multispecies ethnographic inquiry about everyday life with bokashi in the Nordic countries mainly in Finland. I have learned to make bokashi in my own family of four human inhabitants, and I have kept a "bokashi diary," which fluctuates from engaged enthusiasm to aversion and disappointment. In addition to recording my own experiments with bokashi, I have visited bokashi households in Finland making participatory on-site observations.[4] The most intensive fieldwork period took place during the academic year 2019-2020. In an attempt to follow the annual cycle of bokashi making, I visited a different bokashi household each month throughout the year, resulting in 12 in-depth interviews with bokashi practitioners and engagements with their bokashi buckets. Due to the pandemic situation, some of the visits were made online. The participating households were recruited via Finnish social media groups dedicated to bokashi making. The households were located in every part of Finland, and they represented different ages, ranging from retired to young adults, and family sizes, ranging from an urban single-person-and-a-cat home to an agrarian model of three generations living in one building. Most of the households were located in urban or semi-rural town edges, but some of them were located in the middle of a densely built city. In addition to on-site participatory observation, I have followed online discussions concerning bokashi making. This multifaceted ethnographic material forms the empirical backbone for this article.

Olfactory Knowing

> Sometimes a batch smells a little bit stronger when I have been too easy on the microbe bran, or when I have put something smelly in the bucket. For instance, onion peels generate "nice" smells. My sensitive-nosed partner always notes that "oh, it stinks here" but I think the smell resembles pickled vegetables. I don't think it's a bad smell at all. (Interview with "Rose")

As we bokashi makers rarely have any technical monitoring equipment at our disposal, we must turn our own bodies into monitoring devices enabling us to navigate through the process of fermentation. Most of the time, we sniff.

Although bokashi is often marketed as an odorless waste-handling method, it is a polyphony of all kinds of smells ranging from lemony odors to vomit-like stenches. Every bokashi batch has its personal fragrance depending on what kinds of materials it has incorporated. A newcomer in a bokashi online group bemoaned that she had never in her life experienced the kinds of smells that she had encountered when mak-

ing bokashi. Bokashi community has developed a rich verbal repertoire, ranging from "vinegary" to "baby vomity," for describing different odors to be able to share and compare their olfactory experiences.

Bokashi makers learn how to attune to the multilayered odors of their bokashi buckets and to sniff out, whether it's time to drain the leachate from the bokashi container, or if the lid of the container has not been airtight. For instance, the irritating fumes that my son detected in the opening vignette were most likely butyric acid, which is sometimes generated in the process, and for the human practitioner, its rancid stench reveals that something is not going right in the process.

In bokashi making, then, smell becomes an important means of gaining knowledge about what is happening in the fermentation bucket. Having this kind of tacit understanding of different olfactory hues is a skill rarely needed in the modern world. As Constance Classen, David Howes, and Anthony Synnott (2002) point out in their cultural history of smell, smells have been typically repressed in the sensory order of the modern West. Since Antiquity, the sense of smell (and taste) has been considered an irrational sense related to embodied affects and emotions, and as such unnecessary for any rational meaning-making processes. Thus, the sense of smell has been deemed a "lower" sense connected to primitive instincts and survival (Classen, Howes and Synnott 2002; see also Mol 2022). The modernity has valued the sense of sight over other sensory modalities (Classen, Howes and Synnott 2002; Howes and Classen 2014; Mol 2022; Pink 2012). Classen, Howes, and Synnott (2002) argue that the ocular ideals of modernity have effectively deodorized all areas of urban Western life from sciences to city planning. This downplaying of smell continues today: when UK citizens were asked to rank their most and least valuable senses, the sense of smell was ranked least important (Enoch et al. 2019).

However, although the significance of the sense of smell in navigating through the modern world has been played down, even us modern, urban humans constantly interpret the lived environment through our noses. We receive and interpret masses of information about the chemical constitution of our surroundings, which warns about dangers such as pollution or fire, and enables us to read the atmospheres or moods of our companions (Pelosi 2006). Behavioral studies of human olfaction have stressed the important role of smell in food consumption and danger avoidance but also emphasized that odors are socially meaningful, not only in mate attraction but also for religious, medicinal, and aesthetic purposes (Majid 2021, 111). Social sciences of embodiment, e.g. feminist and practice-based approaches, have further emphasized the importance of pre-reflexive and corporeal, more intimate and sensory modes of knowing and relating (see e.g., Riach and Warren 2015). Embodied approaches sometimes suggest that corporeal *ways of sensing* (Howes and Classen 2014) may even be understood as primary modes of knowing and being-in-common because they pre-date the cognitive rational processes (Diprose 2002). In a similar vein, Annemarie Mol (2022) argues that it would be an underestimation to define smell and taste as merely proximate senses that provide knowledge about our own bodies and sensations – they are also means of orienting in relation to the environment.

Indeed, although smells are rarely noticed when there is nothing out of the ordi-

nary, they are an effective means of gaining information about the environment. Pleasing smells draw us toward their source, whereas repulsive odors work effectively like warning signs (Pelosi 2016). Just like my son, who escaped from the kitchen before he realized what had hit him, strong odors can force your body into action before the message has entered the reflexive part of the brain and has been coded into an intelligible thought. Smells have a power to make us act before we think because the smell has a direct pathway to the limbic system. That part of the brain is also responsible for memory and emotion, which is why sense of smell is strongly linked with emotional memories (De Bruijn and Bender 2018; Willander and Larsson 2006; Larsson, Arshamian and Kärnekull 2017). Tight connection of smells and emotions might also give a partial explanation for why bokashi making is often experienced as pleasing and rewarding, sometimes even sensual. For many, the olfactory engagement with bokashi matter is an important part of the charm of bokashi making. When I asked the online bokashi community what in their opinion was the most appealing thing about bokashi making, many of them answered that they enjoyed the odours most: "The additional bonus is all the enchanting whiffs you encounter when opening the lid, reminding you of the recently savoured treats – sometimes sweet strawberry, sometimes bitter lemon."

Despite their seemingly natural character, smells do not reveal an innocent or neutral truth about the world. Rather, how one interprets and reacts to a certain smell is a complicated cocktail of biochemistry and culture. Cultural studies scholars of senses emphasize that sensory perception is never separate from the cultural and material context where the perception takes place (Howes and Classen 2014). What I consider a pleasing or a disgusting smell is a result of my current situation, personal experiences, habits, and cultural customs passed on through generations, merged with information coded in my genes during millennia of evolution (see e.g. Gottfried and Wilson, 2011). Due to its affective and seemingly "natural" origin, olfactory classification is also a powerful political tool. Familiar or strange smells efficiently yet ineffably classify something—or someone—safe or dangerous, a friend or an alien (Classen, Howes and Synnott 2002). However, the multilayered odours of bokashi rarely operate on this kind of a simple "good or bad" axis. Instead, they provide a somewhat quirky scale from "charming" and "lemony" to "eyebrow-curling" aromas. As smells are politically used to affectively separate "us" from "them"—whether human or nonhuman—learning to tolerate, accept and sometimes even welcome different and strange smells into one's own home is also a political act.

Microbial Relations

> I think about the microbes in bokashi leachate as my buddies. Sometimes, when the liquid has an awful stench, I reassure myself that despite the smell, it is nevertheless the earth's buddy; it feeds the earth. It nurtures the bacteria in the earth so that erosion will not impoverish the soil. (Interview with "Violet")

When I started fieldwork in bokashi community, I noticed to my surprise that almost all the bokashi practitioners were constantly talking about *microbes*. Bokashi practitioners were aware of the micro-organisms in the bokashi substance, and often referred to them as "buddies." I soon realized that rather than treating the material in the bokashi bucket as generic "waste" or static "matter," bokashi practitioners were reaching out to the invisible beings working and living *within* the waste matter. As my research participant Iris puts it, through making bokashi, she became aware of the "microbial sphere of the world." Before, she had been aware of the visible beings in the soil, such as worms and insects, but the soil and waste themselves had remained inanimate to her.

Indeed, when a newcomer such as me enters the bokashi community, they are rapidly introduced to the world of microbes. Typically, a new bokashi practitioner is instructed to start the fermentation by utilizing commercial bran inoculated with a consortium of beneficial microbes, consisting mainly of yeasts, lactic acid bacteria, and purple bacteria. Bokashi practitioners learn that the fermentation in the bokashi bucket depends on symbiotic collaboration of these beneficial "effective microbes." These are the ones that the bokashi practitioner needs to engage with in order to support healthy lactic acid fermentation. These microbes are "the ones doing all the fabulous work," as explained by one of the pioneering Finnish bokashi practitioners. She continues: "We don't see them, but we can feel their presence. When we put our hands into the soil factory and press the fresh black bokashi soil between our fingers, we can feel all the microscopic life swarming in the soil."

Linnea, a retired bokashi practitioner from southern Finland, articulates this commonly shared conceptualization of microbes as "co-workers" (see also Helmreich 2007; Paxson 2013). In the interview, Linnea notes that when surfing various discussion forums focusing on fermentation, she often encounters "tidy young people" who have cleaned their utensils with chlorite, and then wonder why their ferments always turn moldy. She continues, "There you have it. Mold sneaks in when there's nobody at home. These people don't have any guardians in their fermentation containers." Linnea explains that she is not afraid of the smells, as they are an intrinsic part of the practice.

Through encountering these kinds of stories, a novice bokashi practitioner becomes familiar with the "microbial sphere of the world." Rather than being encouraged to name and identify individual micro-organisms in the bokashi bucket (that would be an impossible task), novice bokashi practitioners are taught to treat their microbial collaborators as fluid pluralities, whose identity is never fixed. Bokashi as a unit, then, is an ever-changing plurality. The presence of these pluralities is mainly "felt" by smelling. Human senses are not sensitive or skilled enough to identify the exact micro-organisms, but they can be useful in monitoring the *microbial processes* taking place in the bucket. Through exposing and sensitizing themselves to different and curious olfactory registers, bokashi practitioners develop more nuanced sensory literacy of different smells. For instance, a writer of a blog called "Bokashislope" describes how attuning to the smells paces their domestic bokashi routines: "I aim for twice a week (to drain the leachate) as I find that at that interval the scent is more cider

vinegar and less old-gym-sock pickle."

However, cultivating new olfactory tolerance does not result in unconditional generosity or convivial togetherness with all kinds of beings. Practicing bokashi composting requires constant negotiations, and exclusion of certain elements as well. By knowing the tricks how to keep the "gym-sock-pickle" smells away from the process, the bokashi practitioner creates favourable conditions for fermenting bacteria (the firmicutes) they want to ally with, and avoids factors that cause rancid odours since the odour is considered the first sign of potential pathogens starting to dominate the process.

If the practitioner has been neglecting the bucket for too long, it sends out a "stinking objection," as the bokashi community mockingly says. When something goes wrong and a bokashi batch turns awry, it transforms into a "Stinky" (named after the rogue, unpleasantly smelly Moomin character),[5] as happened to me in the opening story. As feared as Stinky's visits are, he is also considered an efficient teacher, because once you've encountered him, you are willing to do all you can to avoid his return. However, the bad smell is not a reason to abandon the batch, but rather a challenge to do something. Rather than being ignored or denied, the strange and even unpleasant smells may be approached as curious challenges or questions. The stench is a means to reach out to the human tender. A cry for help, as it were. A disturbing smell makes you ask: "what should we do about it?" Ideally, it's enough that you just sit back and enjoy the fragrances, sometimes you might need to add some more carbohydrates (maybe eat a banana?) or add some more bran, or make sure that the lid is sealed well enough.

For bokashi practitioners, then, smelling is not only a one-directional means to obtain information. Rather, a smell is an ethical call that demands a response. Bokashi makers often describe their engagement with the bokashi as a reciprocal form of negotiations or conversations with the microbial communities living in the bokashi matter. These conversations take place in the olfactory register.

Smell as Transspecial Correspondence

Bokashi practitioners often say that bokashi communicates about its well-being through its smell. How, then, to describe these subtle forms of chemical communication going on between species big and small? Anthropologist Merlin Sheldrake has suggested in his bestselling book *Entangled life* (2020) that we should expand our concepts of communication so that speaking might not always require a mouth, hearing might not always require ears, and interpreting might not always require a nervous system (Sheldrake 2020, 46). Experts studying olfaction and chemoreception agree that smells are a form of communication. Scholars of olfaction (e.g. Gottfried and Wilson 2011; Pelosi 2016) maintain that the sense of smell is basically an ability to read chemical messages and react to them. What we perceive as different smells are a mixture of "odorants," gaseous volatile compounds carried by the air to the receptors of our olfactory organs, which in human body are located in the nose. The sense of smell is vital for survival and reproduction for most animal species from beavers to insects,

worms, and fish. If the concept of olfaction is expanded to the broader concept of chemoreception—which means the ability to monitor the chemical composition of the external environment and respond accordingly—even plants and simple organisms such as bacteria and protozoa utilize chemical communication as a means of communication (see e.g., Gottfried and Wilson 2011).

It is therefore not far-fetched to say that microbial communities in bokashi and humans communicate through the smell. Is it possible to understand olfactory engagements that I have described above, as communication between species, or perhaps, to keep away from a language-centered idea of communication, as a form of *transspecial correspondence*? I borrow the concept of correspondence from anthropologist Tim Ingold, for whom correspondence is a way of capturing the co-constitutive dynamics of being: "correspondence is a joining with; it is not additive but contrapuntal, not 'and…and…and' but 'with…with…with'" (Ingold 2020, 13). Correspondence aptly describes the act of being attentive to the world, being part of it, and responding to it. For Ingold, to correspond, is to "join our lives with those of the beings, matters and elements with whom, and with which, we dwell upon the earth."

Mushrooms are an illustrative example of such biochemical correspondences between species. Sheldrake (2020) muses that fungal mycorrhiza is a chemical organ, swimming in a sea of chemical information. They are covered with receptors to which volatile molecules can attach triggering a signal that changes the behaviour of the fungi. He describes how truffles utilize strong odours to attract animals, which then spread their spores. Truffle's molecules contain androstanol, a component which is also present in pig pheromones that make it smell so irresistible to pigs. Similarly, other fungi, such as matsutake, utilize peculiar smells to attract animals to spread their spores. Mushrooms hence reach out to other species through olfactory means. As Tsing (2016, 46) poetically puts it, smell is "a sign of the presence of another, to which we are already responding."

In bokashi practice, the constantly ongoing correspondence takes the form of sending and attending to chemical messages and responding to them with hands-on, material means: Microbial communities in bokashi substance send out gaseous volatile compounds, humans monitor the chemical composition of the environment through their noses and respond accordingly, the exchange continues in a response (for instance by limiting oxygen intake or by adding microbes or carbohydrates). Finally, bokashi responds by chemically reacting to the changes in their environment. Of course, this affective, sensory, physio-chemical correspondence does not only take place between the human and bokashi, but all the sentient beings in the household. For instance, pets and insects are often attracted by the fermenting material, if they have access to it. It is also often instructed that culinary ferments, such as sourdoughs and kombuchas might be affected by other microbial communities nearby, so they should be kept separately.

In intracorporeal correspondences between bokashi and bokashi practitioner, gaseous smells leak from bodies and mix with other bodies. By spreading volatile compounds, other species penetrate human bodies and make them act—more or less voluntarily. Embodied reactions—whether repulsed withdrawal from or thrilled engagement with or something in between—work as a response. The exchange continues in

adjustments of metabolic conditions to which the microbial community of bokashi substance responds in a matter of time.

Sniffing New Relations

In this article, I have sought cultivate, nourish, and share other kinds of stories that may hold promises of modest yet radical hope. I began this paper by asking, what kinds of worlds may be storied when what and how we smell is taken seriously. To do so, I adopted a mode of multispecies storytelling as a speculative tool for recognizing stories of togetherness and responsiveness beyond human language. Further, I focussed on olfactory engagements with bokashi composts and set out to speculate "not-yet-articulated agendas" and "unexpected allies" through the experiment of "sniffing politically."

Bokashi, along with other vernacular fermentation practices discussed in this issue has proved helpful in sniffing not-yet-articulated agendas and unexpected allies with beings that are invisible to the unaided eye. In a similar vein, fermentation activist Sandor Katz (2020) has suggested that hands-on fermentation practices offer a means to engage with microbes and experience (human)existence as a distributed, interdependent ecosystem rather than a self-contained individual. Indeed, along with the stories of relating with the microbial waste matter, the visceral, sensual practice itself allowed bokashi practitioners to "feel" the multitude of microbes that inhabit the bokashi bucket. Through its smells, bokashi penetrates the body and thus unsettles the idea of a human body as a well-defined container, an idea that still sticks surprisingly tightly in the Western imagination and gives shape to political agendas. By cultivating more permeable imaginaries of how and with whom to be human, olfactory stories of bokashi composting may then have even ontological consequences.

Dirty and stinky engagements with bokashi enable paying attention not only to the celebration of friendly conviviality but also to the constant and often untidy negotiations and exclusions that take place in real-life human-microbial relations. As Sebastian Abrahamsson and Filippo Bertoni (2014, 125), themselves studying vermicomposting,[6] note, composting is not only about togetherness but also about exclusion and separation. Instead of a one-solution-fits all, successful composting demands constant sensory monitoring of the bin and deciding what goes in and what is kept out of it. For instance, some bokashis do not metabolize coffee grounds well (which they express by stinking) whereas others do not mind. Moreover, to generate healthy soil, the vermicomposter has to learn to "speak worm" by tuning into the metabolic processes of worms. Similarly, the bokashi maker, too, learns to "speak" the olfactory, metabolic language of bokashi, and thus to tune into conversations beyond human language.

In the process of learning to "speak bokashi," I have grown accustomed to interpreting a whole spectrum of olfactory cues, ranging from pleasant sour whiffs to slightly repulsive vomit-like stenches. I have learned to accept these messages from unfamiliar others into my home and my body, as something that in all their uncanniness escapes the continuum of "us" and "them." However, I do not welcome all

kinds of odours or all kinds of beings into my bokashi bucket. Instead of practicing unconditional generosity, we bokashi makers learn to navigate by the smell to keep the process on the "good side." Rather than trying to manage and control the exact composition of each batch, I need to accept a certain level of uncertainty. I have begun to tolerate a diversity of strange and even unpleasant smells and to welcome a range of peculiar materialities as part of my everyday life. I have learned to separate a 'business-as-usual' kinds of smells from rancid smells that are a cry for help, demanding attention and care. If I pay attention, the whiffs tell ephemeral stories about what is happening in the bucket—but I can never be absolutely certain.

Coda

A few months have passed since my encounter with food waste gone bad. I have collected the bokashi bucket as full as possible and then sealed the bucket for fermentation. Every now and then I have drained the leachate from the bottom of the bucket, and absentmindedly marked that the smell of the liquid has been almost if not entirely pleasing. A few weeks ago, I have opened the bucket, moved the fermented matter into a large container, and mixed it with soil that I had dug up from my backyard. First snow has fallen unexpectedly early, and my family is gathered in our backyard to prepare the garden for the winter. I carry the container outside from our garage, and inspect its insides in the bright daylight, and stick my fingers into the dirt to check whether the transformation into soil is ready. Nothing seems to be out of the ordinary, and I shovel the contents into the garden. I can feel that there are a few big lumps left, but most of the waste matter has been thoroughly incorporated into the soil. Only occasional off-putting fumes evaporate into the air and make my family members smirk with disgust when the smell reaches their nostrils. Usually fully transformed bokashi soil smells so earthy and pleasant that I often feel the urge to bury my nose in it. This time I have to admit that not even I can enjoy the smells. Nevertheless, I am happy that we made it; I responded to the cry for help, and together we turned the composition of the matter so that it was able to transform from a decaying matter into fertile soil, which will continue its life in my little backyard.

Notes

1 About problems of Western waste relations, see e.g. Bell 2019
2 For a more extensive analysis of how bokashi changes urban waste relations, see Kinnunen 2021 and 2023.
3 All the quotes have been translated from Finnish by the author.
4 I have anonymised the interviewees with names of Finnish flowers.
5 Moomins are famous fictional characters created by Finnish author and artist Tove Jansson.
6 A method of composting with the help of soil worms.

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In the Company of Bread: Sourdough Baking as Symbiotic Care

Ragnheiður Maísól Sturludóttir
University of Iceland

Jón Þór Pétursson
University of Iceland

Abstract

Sourdough baking is a mutualistic project that involves collaboration from humans and microbes. A loaf of sourdough bread is the result of a symbiotic relationship based on reciprocity between the baker and microbes. The baker is equally dependent on the microbes in the sourdough as they are on the baker. He feeds and cares for them, and they return the favor. Here, we propose the concept symbiotic care *to analyze the interspecies collaboration between humans and microbes through sourdough baking. These mutual social practices dictate the rhythms of everyday life and are part of a broader ecosystem that connects all forms of life. Caring for sourdough mothers and baking sourdough bread can be considered a form of self-care that always involves other species, emphasizing the mutualistic aspects of interspecies collaboration and expression. This symbiotic collaboration and care through time demonstrates how different communities of microbes have co-evolved with human bakers and shaped their common history. For a long time, sharing sourdough mothers has been a part of multispecies commensality and community making. However, there is another side to this story: the microbes that the sourdough mother consists of have also been creating their own communities over time. To share sourdough mothers that, in turn, share human bakers illustrates symbiotic care in everyday life.*

Keywords: sourdough; symbiotic care; time; multispecies collaboration; multispecies commensality

Introduction

> I was really stuck in all the rules, thinking it was some complex biology or math. I had an old Nissan Almera, and I went out partying, but I was always going out to the car because I had the dough in the back of the car. There is nothing normal about that. But that's the way I was then. I said to my boyfriend that either I take the dough with me, or I won't go - I am baking! (Interview No. 3 2020)

Sourdough baking is a serious commitment. It demands mutual care and collaboration from humans and microbes. Taking care of a sourdough mother demands patience, affection, and sometimes, going to great lengths to meet her needs, like bringing her along in the backseat when going out partying. This is microbial adult supervision.

Cultural Analysis 22.2 (2024): 76–95

During the COVID pandemic, the Icelandic sourdough group on Facebook grew exponentially. From March 2020, when the first restrictions took effect, until May 2020, the group grew by 78%. Before the pandemic, the group had around 3,500 members but has almost quadrupled in size, now counting around 13,700 members.[1] During the pandemic, photos of homemade sourdough bread, sourdough buns, and sourdough pizzas proliferated, accompanied by memes and narratives of both successes and failures in cultivating and caring for sourdough mothers (Byron 2021; Delap 2020). The sourdough Facebook group also became popular for sharing sourdough starters and different recipes. In that sense, sourdough became a powerful symbol of resilience, relationship-building, and care while people lived under the constraints of shutdowns and quarantines. At a time when life and its usual rhythm were disrupted and controlled mainly by the unknown, sourdough baking was, for some, a way to "restore a sense of an organized and structured everyday life" (Arantes 2020, 43). Others felt that sourdough baking brought them a sense of community by sharing baking recipes, experiments, and microbes with friends and family who were also baking during the quarantine (Siragusa 2020). As Michael Pollan has noted, people who ferment seem extremely generous when sharing their knowledge, recipes, and cultures with each other (Pollan 2013, 232). When disinfectant dispensers became standard equipment for everyday living, more and more people deemed it important to spend their time engaging with and nurturing this microbial soup that a sourdough mother consists of (Long et al. 2021).

During the pandemic, many people thus suddenly found themselves living a life where they had much more time on their hands, as the ethnologist Tine Damsholt has noted. The pandemic was time that could be used for crafting, reading, and baking sourdough bread (Damsholt 2020; see also Sofo, Galluzzi and Zito 2021; Ocklenburg 2020). However, most bakers featured in this article had all been baking before the pandemic hit. They perhaps had more time to bake and share the results on social media during the pandemic, but it was not the beginning nor the end of their baking, nor were the meanings attached to this practice.

Sourdough, or sourdough mother or starter, is a wild yeast used to make bread and pastries. It is made by mixing flour and water. The mixing activates bacteria and microbes from the flour, water, and the atmosphere, initiating a fermentation process that produces gas and makes the dough rise. One can either start one's own sourdough or get a little bit of someone else's sourdough, for sourdoughs can, with the proper care, be kept alive for years, decades, or even centuries. However, care is an indispensable ingredient whereas a baker can only bake bread with a good and healthy relationship with the microbes in the dough. Fermentation is, therefore, "an intentional act of care" (Drain 2021). For the microbes to survive, the sourdough baker must take care of the sourdough by feeding it regularly with flour and water. Some bakers feed their sourdough daily, even two times a day if baking regularly, while others keep their sourdough in the fridge and feed it every other week or so. If the microbes in the sourdough are not in good balance, the bread will not rise and may end up tasting bad. A delicious loaf of sourdough bread is, therefore, the result of a symbiotic relationship based on reciprocity between the baker and microbes; the baker is equally

dependent on the microbes in the sourdough as they are on the baker. He feeds and cares for them, and they return the favor. In other words, baking sourdough bread can be defined as an "intimate working relationship between microbes and humans" (Lee 2010, 176).

In the article, we propose the concept *symbiotic care* to analyze the interspecies collaboration between humans and microbes through sourdough baking. These mutual social practices dictate the rhythms of everyday life and are part of a broader ecosystem that connects all forms of life. Caring for sourdough mothers and baking sourdough bread can be considered a form of self-care that always involves other species, emphasizing the mutualistic aspects of interspecies collaboration and expression. Furthermore, we explore how the symbiotic care inherent in human-microbial sourdough practices influences and structures the experience of time. To investigate these practices of humans and microbes, we ask the following questions: What can *symbiotic care* tell us about interspecies collaboration, and how does this collaboration unfold daily? What does the temporality of sourdough baking and caring for the sourdough mother mean in the everyday life of the sourdough baker?

Mixing the Human-Microbial Dough

The materials for this article have been gathered from various sources and different ethnographic sites. They include in-depth interviews with humans, interaction with moody sourdough mothers, a questionnaire, a Facebook group on sourdough baking, as well as material culture in the form of freshly baked bread. The ethnologists Tom O'Dell and Robert Willim (2011) suggest that ethnographies should be understood as compositions. As compositions, ethnographies are not produced in one place but develop from ethnographic activities at multiple sites overlapping in various ways. Furthermore, O'Dell and Willim argue that ethnographies should be understood as fashioned from a "multitude of bits and pieces" (2011, 31) that are made through multiple experiences and encounters in collaboration with informants (O'Dell and Willim 2011). Here, we build on this understanding to incorporate interspecies collaboration of human bakers and sourdough mothers. This multispecies collaboration produces ethnographic compositions that "is concerned with the effects of our entanglements with other kinds of living selves" (Kohn 2007, 4; see also Helmreich 2010). This approach acknowledges the subjectivity of other species than humans and the multispecies relationality of agency.

Human bakers and sourdough mothers could thus be defined as "mixmates" (Franklin 2008), working together to make sourdough bread. Various scholars have pointed out that we have never *only* been human (Haraway 2003; Latour 1988, 2004). As Donna Haraway has taught us, being human is to be more-than-human; it is to "become with" other species with whom we share life: "to be one is always to become with many" (Haraway 2008, 4). The English word *companion* derives from the Latin word *com* (together with) and *panis* (bread). In French *compagnion* means: one who breaks bread with another. Sourdough mothers as companion species (Haraway 2003) thus describe both the biological relationality of humans and microbes, and the social

aspect of multispecies commensality.

Among other sources, the article is based on seven qualitative in-depth interviews (Taylor, Bogdan and DeVault, 2016) with eight experienced sourdough home bakers of different ages in Iceland. The interviews were conducted between 2020–2021. The bakers had all been baking for a minimum of three years by the time they were interviewed. Their symbiotic relationship with their sourdough was thus present in their everyday life prior to the pandemic. All of the bakers baked on a regular basis with occasional breaks during busy times in their lives or when traveling. Four of the interviews were conducted in the baker's home, where the participants either had freshly baked loafs or were making dough during the interview. Three interviews were conducted online due to restrictions that resulted from the Covid-19 pandemic. Participants were found through various methods. Some were referenced to the interviewer, some were found through advertisements on social media, and others were long-term sourdough bakers that the interviewer knew or knew of. The interviews focused specifically on sourdough baking in the home, where participants were asked to describe their baking practices in detail and comment on the values behind baking one's bread. In addition to exploring different temporalities in relation to sourdough bread-making, the interviews also investigated the methods of the sourdough bakers, the reasons why they use these methods, and the emotional connection bakers have to their sourdough. Furthermore, the interviews explored whether naming one's sourdough is a common custom amongst sourdough bakers and, if so, what naming traditions are most common.

Moreover, we draw upon a response to a questionnaire that was sent out in collaboration with the National Museum in Iceland (ÞÞ 2022-4). The questionnaire was about fermented foods in general and asked about different aspects of working with fermented food at home. It asked questions such as what methods people use, what kind of food they ferment, where and how they learned to ferment, and how they think and feel about the microbes in the fermentation process. People who answered the questionnaire participated in various fermentation practices that included sourdough baking, making kombucha and yogurt, fermenting sauerkraut, and brewing beer at home. We have sorted out relevant answers where informants talk specifically about sourdough baking. The interviews and the questionnaires complement each other as questionnaires are convenient for collecting material from many informants (see Kjus and Grønstad 2014).

In contrast, the interviews provide an opportunity to approach the topic more deeply, and the researcher can guide the conversation. With questionnaires, the informant may interpret and choose which questions to reply to and how to respond. It is, therefore, likely that the answers in the questionnaire are both carefully selected and filtered (Marander-Eklund 2012). The questionnaire answers include what matters to the informants, expressed in their own words, and the practices, impressions, and emotions connected to sourdough baking.

In addition, we rely upon posts on the Facebook page of Súrdeigið (The Sourdough), which includes discussions between bakers, pictures, and memes on everything sourdough. The posts express various emotions connected to the successes and

failures of sourdough baking and how taking care of and baking from the sourdough mothers affects everyday life. Ragnheiður Maísól, the co-author of the article, is an avid sourdough baker. Her interest in the subject, therefore, comes from her own personal experience of a symbiotic life with the same sourdough mother for over a decade. She has a deep understanding of sourdough baking, which meant that the interviews focused more on the effect sourdough baking has on the baker's everyday life, rather than the baking process. She is also the founder of Súrdeigið (The Sourdough), the Icelandic Sourdough Facebook group, and has been following the sourdough community in Iceland closely for the past years. When searching for informants, both active members of the group as well as bakers who do not use social media were included and interviewed to represent a more diverse group of bakers.

The Cyclical Time of the Sourdough

Figure 1. A bubbly sourdough mother. Photograph (2023) by Ragnheiður Maísól Sturludóttir.

Sourdough can be categorized as *slow* food: making and baking a loaf of sourdough bread can take up to 72 hours. To start making a good loaf of sourdough bread the baker must have access to a healthy and bubbly sourdough mother fed in the previous 4 to 12 hours. When the sourdough mother has been fed, the microbes in the dough take over and start munching away, giving the dough its distinct sour flavor and form-

ing carbon dioxide, which is visible to the baker as bubbles in the dough (Meyer 2014, 42). When mixing dough for a sourdough loaf, the baker takes a bit of the sourdough mother and mixes it with the dough, starting the fermentation of the dough. If a short time passes from feeding the sourdough mother to mixing the dough, the microbes in the sourdough have not begun working properly, and the dough will not rise. If too much time passes, the microbes in the sourdough mother have finished all their food, resulting in a sour smell and taste and a dough that does not rise properly. For successful sourdough baking, it is important that the baker takes good care of the sourdough mother and keeps it healthy. Usually, the baker feeds the sourdough mother right after using a part of it to mix the dough. The cyclical time of the sourdough is, therefore, intertwined with the practice of baking, with the bread being a result of regular engagement with the sourdough's cyclical rhythm.

There are countless ways and recipes one can use to bake sourdough bread. Most of them call for a process with two steps of fermentation. The first fermentation, often called bulk fermentation (Hamelman 2013, 13), usually lasts 6 to 10 hours. At the start of the bulk fermentation, the baker often needs to knead or fold the dough and keep an eye on how the fermentation goes; that is, tune into the microbes. After bulk fermentation, the dough is divided up, shaped, or put into bread tins and given a second rise. For the second fermentation, bakers often prefer to leave the dough in a fridge. The dough rises slower in the fridge, giving the baker a bit more freedom to bake the bread when it fits his everyday schedule. A cold fermentation also gives the microbes time to give the bread a deeper and more complex flavor (Reinhart 2016, 62), which many bakers seek.

In contrast, a loaf of bread made with baker's yeast, which has been dominant as a leaven in dough making for the past century, only takes a few hours to make. Only recently has sourdough made a comeback into the culinary scene, with sourdough bakeries becoming more popular and sourdough bread a standard within the restaurant branch. Despite this recent surge in popularity, sourdough baking is far from new. Some forms of fermented bread are even believed to date back as far as 4000 years B.C. (Pollan 2013, 124). It is, in fact, the commercial baker's yeast that is a relatively recent invention, only dating back to the end of the 1920s (Lahue et al. 2020: 3). The invention of baker's yeast came alongside temporal changes in societies where people were moving away from living according to the seasons and structuring time in a linear way that could perhaps be described as time being "straightened into an arrow" (Dawdy 2010, 764). Time became a commodity, a unit that could be bought and sold, and its price negotiated in labor disputes. Instead of doing the daily tasks in rhythm with the rise of the sun and the run of the seasons, people were controlled by the factory whistle (Löfgren 1987, 25). Using time efficiently meant that more things could be produced, enhancing profits. The production of bread was no exception to this.

Sourdough baking is not only a slow process it can also be an unpredictable one. Various factors affect how slowly or quickly the sourdough proofs, and some are hard to control, like the weather and microbes in the environment. Unlike sourdough, baker's yeast does not need to be attended to regularly, and fewer outside factors affect the way the dough proofs. The invention of baker's yeast made the bread-making

process quicker and easier to control. By making bread with baker's yeast, bakeries could now produce more bread in less time. The bread was also cheaper than before, so many homemakers opted to buy bread from the bakeries instead of using their own (valuable) time to bake bread at home (Bobrow-Strain 2012). Today, most people still buy their bread at the supermarket or from the bakery. Life is still guided by linear time, where the use of each time unit is to be maximized, and time always seems to be in short supply.

The culinary turn to artisanal food products such as sourdough bread can partly be attributed to people's interest in wholesome food and a desire for a slower lifestyle (Osbaldiston 2013). A baker who began baking sourdough bread during Covid said that her mindset had changed recently, "the slower things are more important than they were before" (ÞÞ 2022-4-2). In times of crisis, slowing down can become a coping strategy to manage everyday worries and maintain calm (Siragusa 2020). The fermentation of sourdough is a natural slow process. The microbes and the bacteria in the sourdough make the dough rise and fall at its own speed, a process that is repeated with each feeding. The inner time of the sourdough may be described as cyclical, a space of time found in many other natural elements that affect our everyday lives. The seasons are a cycle of repetition; menstruation is counted in cycles: the beating of our hearts and the sleep-wake cycle. The temporality of life is, therefore, characterized by various cyclical processes manifested in bodily experiences. However, Western thought has increasingly subscribed to a linear and progressive notion of time in the modern age. This Western notion of time sees life as having a beginning and an end, where life is always moving towards the future, the new. This is a sense of time where physical events cannot be repeated; each moment is forever spent. In our everyday life, which is mostly run by the clock and linear time, we constantly try to "synchronize the multiple times into temporal and material assemblages" (Damsholt 2020, 139). It is, therefore, interesting to ask why, today, when time is considered a scarce commodity, and sourdough bread can be bought on almost every corner, home bakers opt to spend their time attuning to the slow time of the microbes and making bread at home.

Sourdough is a living organism that has, in many ways, successfully evaded this Western notion of time; it is not so easily controlled and does not abide by the clock. The baker needs to be attuned to the temporality of the microbes, and for some, it can be a stressful event to start taking care of and baking from sourdough. Neophyte bakers are often advised to keep a close eye on their sourdough to familiarize themselves with the dough and study its moods and behavior. The same sourdough will act differently depending on the microbial environment, the flour it's fed with, and feeding method. All these different factors can lead to unpredictable sourdough behavior, which can be rather stressful for beginners. As many factors can affect the sourdough's behavior, it is often hard for a new sourdough baker to realize why the dough behaves the way it does. The most common questions posted on the wall of the Icelandic sourdough Facebook group come from inexperienced bakers wondering why their sourdough is behaving in certain ways: Why is the sourdough not rising properly? Why are there so few bubbles in the sourdough mother? Is the texture of

the dough supposed to be thick to the point of being stiff, or should it be runny like a soup? These worries concerning the sourdough mother illustrate the difficulties in synchronizing different temporalities, where the baker's understanding of time as linear clashes with the cyclical time of the sourdough mother.

Different temperatures inside kitchens also affect the behavior of the sourdough. A warmer kitchen will make the dough rise faster, and so will mixing the dough with warm water. However, if the kitchen is too warm, the bread can become over-proofed and thus taste too sour. Bakers who start baking during the summer are often shocked once winter arrives and their sourdough starts to act differently. A home baker who had been baking for over thirteen years still remembers a winter of failures at the start of his sourdough journey. No matter what he did, his bread didn't turn out the way he wanted it to:

> In the end I just had to admit defeat. It was freezing cold outside, and I just couldn't get it to the right temperature. And lo and behold! As soon as spring came my sourdough mother came back to life. (Interview No. 7 2021)

The cyclical time of the sourdough is thus influenced by the run of the seasons. Later, the baker bought a heat-controlled proofing box to better control the environment of the sourdough and made sure he would never again experience the frustration of his first winter of sourdough baking. His experience reveals the interconnectedness of the place, the liveliness of the sourdough and the importance of weather in the symbiotic practice. The example highlights how the agency is relational, and that baking sourdough bread is a collaboration between humans and the microbes that make up the sourdough mother. As Edwin Sayes notes, "nonhumans do not have agency by themselves, if only because they are never by themselves," but of course, the same may be said of humans—as is evident in the baking of sourdough bread (Sayes 2014, 144). Agency between humans and nonhumans—sourdough microbes included—is thus best described as relational, spun between social actors (Whatmore 2002, 4; Barad 2003). This relationality also raises questions about who, or what, is in the driver's seat when it comes to this co-production of bread loaves.

When asked who is in control, the baker or the microbes, another home baker said: "The microbes definitely. I need to wait for them to finish their job. But I can create preferable conditions for them" (ÞÞ 2022-4-41). The baker can strive to create the best environment for his sourdough, but the truth is that the timing of the fermentation is a natural process that we cannot rush. The cyclical time of the sourdough, unlike our linear human time, is a testament to the power and control of the microbes. The baker's role is to work with this natural rhythm and deeply respect it, appreciating the intricate dance of the microbes.

Symbiotic Care

One of the most common worries expressed in the Icelandic sourdough group is the fear of killing the sourdough mother. This stress often drives bakers to give the sour-

dough mothers special attention and delicate care. There are plenty of examples of bakers who take the dough with them to dinner parties or stay awake long into the night just to finish kneading the dough. They do this out of fear of harming the sourdough mother through negligence. A sourdough mother that is used on a regular basis needs ongoing care. It needs to be fed and attended to. Worries about harming the sourdough mother are connected to the fear of disturbing the slow cyclical time of the microbes. If the sourdough mother dies, the baker has failed to care for it. Often, to begin with, bakers take no chances when it comes to the ongoing care of the sourdough. On 28. September 2023, a new baker in the Icelandic Sourdough Group asked:

> Nine days old sourdough mother, doubles in size. I am going to a summer house over the weekend. Is it safe to store the sourdough mother in the fridge while I'm away? Or does it need to go to a sitter? (Facebook 2023)

When taking breaks from baking, it is possible to freeze or dry the sourdough to store it, but most bakers opt to keep it in their fridge and feed it regularly. It is also a common practice amongst bakers to have someone take care of their sourdough when they are away for a long time. A baker who went on a long trip didn't want just anyone to babysit her sourdough. "I got my mom to do the job, the person I trust the most in the world" (Interview No. 3, 2020). The mother, who at the time had not had any grandchildren, posted a photo of the sourdough on her personal Facebook page saying she was babysitting her first grandchild. A baker said that her daughter, aged eight at the time of the interview, knew how to use the kitchen scale and feed the sourdough in case she needed to get her daughter to feed it if the baker was away. In this way, the baker involves her friends and family in symbiotic care of the sourdough, making the caring process a mutual responsibility.

Over time, once the bakers have gained experience, they seem to find it easier to attune to the slow rhythm of the sourdough. A home baker indicated as much, saying:

> I am much more relaxed in terms of baking today compared to how I was to begin with. For a while I measured the temperature of the water, followed recipes to the gram and organized my day around the fermentation of the dough. Today I'm much more likely to measure ingredients roughly and do experiments that result in breads that are not as consistent in looks and quality but most of them taste good. (ÞÞ 2022-4-3)

This is a common experience among the home bakers. The rhythm of the sourdough dictated their everyday life from the outset. They couldn't leave the house at certain hours or, as described in the very first quote of this article, took their sourdough with them when they went out partying. Over time, by regularly caring for their sourdough, they became more relaxed and attuned to the needs of the sourdough mother. The home bakers adapted to the slower time of their sourdough. They cooperated with the sourdough mother to create routines for sourdough baking that suited both the mother and the baker. Many bakers commented that feeding the sourdough is one

of the last things they do in the evening or one of the first things they do in the morning. They have a standard routine: making sourdough pizza every Friday, two loaves of bread on weekends, or sourdough pancakes on Sundays. They all go through periods when they bake a lot and when their sourdough is dormant in the fridge for a while. They no longer worry about disturbing the rhythm of the sourdough as the bakers start to embody this rhythm in their everyday lives.

Baking sourdough bread embodies this temporal synchronization, helping bakers to stay grounded in the present and find calmness. The bakers, for example, talked about baking as a time to themselves. 'Me-time,' if you will. One baker said he preferred baking when he was home alone: "Then I am able to be undisturbed. Sometimes I listen to music but most often not. I just want the silence. I want to fully focus on baking" (Interview No. 7, 2021). A woman who bakes with her husband described how her husband went into his own zone while baking. "He's just fully there" (Interview No. 5, 2021); he can access a mental and physical place through the symbiotic practice of making sourdough bread. A more-than-human place is found, a place which is shared with the microbes in the sourdough.

A baker had been baking for some time before she had three kids in five years, leaving little time for baking regularly. She had wanted to have kids, but she was afraid it would drastically change her, that she would lose herself within the maternal role and, thereby, her independence. At the time of the interview, her kids ranged in age from 3 to 7 years old, and she had recently found time to start baking regularly. She said that despite being very content with her life, the last few years had been overwhelming, with little to no time for herself. However, she got solitary time through baking: "It's a quality of life. I'm not complaining about the kids or their needs but it's so valuable to get to enjoy this breathing space again" (Interview No. 3, 2020). Baking sourdough bread is thus a break from the pressure and manifold tasks of everyday life. Baking is a place of independence for her, a place she says she uses to connect with her former self, who she was before she became a mother.

One baker admitted that she had always been energetic and impatient. However, through sourdough baking, she became a more patient person and found calmness in the process of baking sourdough bread. Although she is still energetic and sometimes impatient, she uses baking as a form of meditation to ground herself against a busy schedule and the perceived acceleration of everyday life. The human-microbial practices of making sourdough bread are thus a prime example of how a sense of time is created through interspecies collaboration. These mutualistic practices create a special rhythm that helps the bakers to experience time more slowly in everyday life, to resist or find an alternative to the demands of modern temporal regimes. Just as with meditation, at the core of caring for the sourdough "lies agency, decision and intention" (Drain 2021). For many sourdough bakers, baking bread, therefore, becomes a part of a self-care routine. This routine was apparent in the words of one baker:

> Over a period of 24 hours, you are attending to the dough for maybe just five minutes in total. But during those minutes you have all your senses open. You are touching the bread, looking at it, smelling it. You are not thinking about anything else at that

> moment and that clears your mind. Even though it's just for a few minutes, you are free from all interruption, just for a short period of time while attending to the dough. I think this has the same effect on me as meditation. (Interview No. 4, 2021)

However, this form of self-care involves multispecies collaboration that demonstrates that humans' physical and emotional welfare is connected to the nurturing of the different ecosystems to which we belong. In many cases, this regular practice of microbial engagement stirs up pleasant emotions for the bakers:

> I love to fold the bread and make dough for pizza. Just feeding her every day brings me great joy and pleasure. The other day I was making dough balls for pizza and an overwhelming sense of happiness poured over me, I even teared up and everything. I think it's this mindfulness people are talking about. I was just there doing this, and it was perfect. (ÞÞ 2022-4-2)

Many bakers describe the profound pleasure of sharing their bread with others. It is the act of giving someone a loaf and establishing and sustaining human relationships. One baker recently gave his neighbor, who just had a baby, a loaf of bread. He described how he was thinking of them while baking the bread and how the gesture represented more than just the loaf: "You hope that people can sense that it comes with love. The process of baking the bread, that is also the present" (Interview No. 4, 2021). The bread materializes the gift of time, a time he spent attending to the sourdough and thinking warmly of his neighbors and their newborn child.

Other informants considered their sourdough baking a form of resistance to several dominating societal trends. One home baker, for example, commented:

> I am the type who wants to fight against this tendency of modern society that everything should be comfortable, quick and simple. In many ways sourdough baking is not quick and not simple. I do a lot of things to try and counterbalance this as I don't think it's sustainable for the future. (Interview No. 1, 2020)

This baker actively engages with the slow time of the sourdough as a form of resistance against the ills of a fast-paced life. The practice of sourdough baking thus demonstrates how people try to counter this linear dominance of time. This notion illustrates how the slowing down time, or taking time to bake, is closely connected to weaving together different temporalities. Furthermore, caring for the sourdough mother connects not only different times but also different people to whom we now turn our attention.

Sourdough Temporalities

Orvar Löfgren notes in another context that objects and things weave together the past, present, and future. In that sense, an object can have the aura of "emotions, longings

and memories" (Löfgren 2016, 60). A sourdough can entail all these things. Feeding your sourdough in the present is a way to gain foresight for your future self so that you can bake from the sourdough soon. Baking from an old sourdough in the present can also be a way to connect to the past. A sourdough that is well taken care of can live for years, even centuries. In 2019, an entrepreneur tweeted that he had, with the help of an archeologist and a microbiologist, brought back to life a 4,500 to 5,000-year-old sourdough found in an ancient Egyptian jar (Elliot 2019). People take pride in having an old starter, and bakeries even use it for their marketing and branding. The Boudin Bakery in San Francisco has a sourdough that is believed to date back to 1894. *The Original San Francisco Sourdough* is a registered trademark (Boudin Bakery 2023). So, when the bakers of The Boudin Bakery are feeding and baking from *The Original San Francisco Sourdough* today, they connect to the bakery's past and its previous bakers, who also cared for and used the same sourdough.

In April 2020, during some of the most onerous restrictions due to COVID-19, a

Figure 2. Jars of Holy Francesca up for grabs. Anonymous Photographer (2023). Published with permission.

woman posted in the Icelandic sourdough group that she recently got her hands on a very old sourdough mother and wanted to spread the love. She had fed it generously and left jars of sourdough mothers outside her home for anyone to take. The jars were displayed in a pretty basket, carefully lined with a colorful napkin. The basket stood some good distance from the woman's front door on top of a big paint jar with a note

that said:

> Holy Francesca, sourdough mother. Originated in San Francisco in 1920 and travelled from there to Sweden (Operakjällaren -> Oaxen -> Álafoss). She came to us 4. April and we named her Holy Francesca. You can take one mother and with her, in love, have many sourdough children.

The jars of Holy Francesca went quickly, and the woman restocked the basket a few times after the first post. For the bakers, this sourdough mother was not just any mother. She was a centurion, presiding over legions of microbes, had survived intercontinental travel, and left trails of bread wherever she went. By taking care of and baking from Holy Francesca, people became a part of her history, creating a sense of historical continuity and roots in an ever-changing world. By baking with Holy Francesca, bakers could travel through time in her company, back to 1920. Even one of the bakers interviewed, who lives on the opposite side of Iceland, had managed to get a hold of a jar of Holy Francesca and swore by its quality.

In sourdough groups online, one can repeatedly see people declare the age of their starter: the older the sourdough mother, the more noteworthy. Some bakers believe that an old starter is likelier to make better bread and survive mistakes and negligence by human collaborators. However, there seems to be no reliable way to determine and confirm the actual age of the sourdough starter (Feinstein 2022). When people say their starter is 100 years old, they must take their word for it. Bakers we interviewed who had gotten sourdough without any specific history didn't really seem to care as much about the age of their sourdough as the ones who had a mother that came with a story. The narrative of the origin of the sourdough mother contextualized her life culturally and socially as a giver of bread. To establish the actual age of the sourdough mothers is perhaps not as important as having a history, a lineage that can be traced back in time and space and narrated when breaking the bread with others or sharing the starter.

For the bakers who had a sourdough mother without a history dating back generations, the mutual and linear timeline of the baker and his sourdough mother seemed to be more important. Many recently hopped on board the sourdough wagon following the increased interest after COVID-19. However, sourdough has been a big part of some bakers' everyday life for years or decades. They have moved between parts of the country, or even between countries, they have baked alongside starting a family, throughout their studies, starting a career, and even into retirement: a life companion. Some have baked bread during the early stages of labor, and to showcase their love and care during times of death within the family. Bakers have described how baking has helped with their mental health during depression, noting that: "... the ability to be able to get so much pleasure out of such a simple process is extremely valuable and important" (Interview No. 1, 2020). For these bakers, the life of the sourdough is intimately connected to their own lives. The everyday rhythm of caring for their sourdough can be a trip down the baker's memory lane. The sourdough, therefore, creates several connections with the past: one's personal history and family history,

and microbial ancestry as a companion species to humans.

In a seminal work on food and memory, David Sutton illustrated how memory is intricately connected to sensorial experience. By exploring the food habits of the inhabitants of the Greek Island of Kalymnos, Sutton demonstrated how people use meals to remember past meals and to plan future meals. By making food, the Islanders gave structure to their individual and collective memory and strengthened their identity (Sutton 2001). This analogy can be applied to one home baker who had started baking in 1984 while studying in Copenhagen. He lived in collective student housing and joined a food club that some students had formed. The club emphasized making healthy food from scratch in order to save money. Every week, the students made a big batch of Danish rye sourdough and shared. When the baker moved back to Iceland, he took a part of the sourdough mother with him and has, since then, baked the same Danish rye bread, using the same recipe with minimal changes, for almost 40 years. He strongly believes you can eat healthy food made from scratch and says he learned to care for his finances when studying. This baker takes great pride in having baked his own bread for all these years, and baking is a big part of his self-image. These views are something he emphasized in the upbringing of his own children. Today, some of his children also bake from sourdough. The story of the sourdough mother is thus not only intricately connected to his biography but also to his family history and future, where one generation after another keeps the tradition alive.

When baking bread over a long period, memory becomes a matter of human-microbial collaboration, shaping how time is experienced and understood. Baking sourdough bread is a mutualistic project involving the baker and the sourdough mother in close cooperation that benefited both: the baker takes care of the mother, and the mother feeds the baker and the whole family. Their existence is intertwined, and their biographies are co-constituted in a textbook illustration of interspecies collaboration and symbiotic living in everyday life.

Taking care of and baking from an old sourdough mother can also be a way for bakers to connect to people of the past. In an article, Salla Sariola describes how she rummages through an old shed to find a vat containing dry crumbles of her grandmother's sourdough. She scrapes some of the dry sourdough from the vat and revives and bakes from the sourdough. Instead of getting her hands on a live sourdough, she chooses to go to the trouble of reviving her grandmother's sourdough, which she refers to as "an archive of past sourdough cultures" (Sariola 2021, 1). The symbiotic care of the sourdough, this more-than-human connection, allows Sariola to connect to her grandmother and her grandmother's history entailed within her sourdough. Caring for the sourdough is a physical act. The baker needs to use his hands and fingers to feed the sourdough. Some bakers even opt to use their fingers to stir the sourdough in each feeding so that the microbes on their hands can blend in with the microbes of the sourdough. The grandmother's sourdough thereby materializes the connection to ancestors of the past.

Research conducted in 2018 showed that eighteen bakers worldwide started their sourdough using the same flour and method. The baker's hands and the sourdough were then tested to see if the microbiome of the sourdough was similar to that of the

Figure 3. The hands of a sourdough baker. Photography (2023) by Ragnheiður Maísól Sturludóttir.

hands of the baker. The research showed that the bakers and the sourdough's microbiome overlapped. When tested against a random starter, the researchers found that the bakers shared a more similar microbial community with their own starter (Reese et al. 2020). That is, the baker's hands affected the final microbial flora of their sourdough. In Korean cooking, which is largely based on fermented foods such as kimchi, the term *son-mat* is often used to describe the taste of the food. *Son-mat* translates as "hand taste," that is, the taste of the person, in most cases the mother, who made the food, or "the care and thought and idiosyncrasy that the person has put into the work of preparing it" (Pollan 2013, 234). Koreans also describe *son-mat* as genealogical, a taste that one acquires by watching one's own mother put love and work into making the food while learning the practice of preparing the food. That is how hand taste is passed through generations (Chung 2021). The revival and rejuvenation of an old sourdough mother is, therefore, not only a subjective meeting point of the past and present but also a symbiotic collaboration through time: the present baker's microbes and the microbes of the previous caretaker of the sourdough. This collaboration, where communities of microbes co-evolve with human bakers, demonstrates how human history is mediated by microbes. Humans create their communities by sharing sourdough

mothers and knowledge amongst one another. In the same sense, the microbes create their communities, sharing bakers between them.

With regular interaction with their sourdough, bakers co-create a human-microbial place in the present that connects them to the past. However, connecting with the microbial ancestry of your grandmother can also become a part of your own microbial future. Another baker said she felt connected to her grandmother whenever she baked from her recipes. This baker had baked the same sourdough bread for seven years. She regularly gave a loaf of bread to her friends and often brought a loaf to family dinners. The loaf was seen by her friends and family as *her* bread, making it her signature baking. She wondered if the recipe would have the same value for her descendants as her grandmother's recipes have for her: "Maybe it's a silly way to leave something behind. It's my bread, my people know what that means. But I find that really precious" (Interview No. 3, 2020). The baker thus thinks about the future while attending to the sourdough in the present, wondering if her unborn descendants will connect to her through the microbial lineage of the sourdough.

The future was a common concern for many bakers, especially when they talked about baking with their children. Many bakers let their children take part in the baking process, some allowing them to assist with feeding the sourdough, while others have a tradition of a family pizza night, where everyone gets to make their own sourdough pizza. These measures are all done in hopes that their children find the same joy in the kitchen as the bakers themselves have. A male baker in his seventies said he baked because he wanted to normalize that men and women have equal responsibility in the kitchen for his three daughters. Emphasizing this, he said: "It's good for them to grow up with that being normal and then they can make that claim to their partners in the future" (Interview No. 2, 2020). The baker himself had grown up with a father who was completely dependent on his wife in the kitchen, not even able to make his own cup of coffee. Through the symbiotic care of sourdough, the baker was trying to break the cycle with his daughters' best interest at heart and making a conscious decision in the present with an eye to their future.

Conclusion

Sourdough mothers and human bakers have been companions for a long time. The making of sourdough bread is an interspecies collaboration that is captured by the term symbiotic care. The bread is thus a co-creation formed by a human-microbial relationship. This symbiotic care involves mutual dependency, where the baker must take good care of the sourdough mother in return for delicious and wholesome bread. The majority emotionally connect to their sourdough mothers, appreciating them, taking good care of them, worrying about their health, and even grieving them when they die. This emotional attachment influences the bakers' lives by shaping their everyday practices and experiences.

In the present, often experienced as a constant time crunch, the slow process of sourdough making can be a stressful addition to the everyday life of the baker. The sourdough and the billions of microbes within can behave in a complex way for the

baker to predict and control. It is difficult or even impossible for the baker to tame his sourdough; caring for it can cause a disruption in other activities such as social gatherings and even sleep. Over time, adapting to the rhythm of the sourdough, the baker learns that the microbes are in control of the process. Slowly, with repeated cycles of feeding, baking, and experimenting with the sourdough, the baker must accept and work around the cyclical time of the sourdough. This results in better bread for the baker and a healthy, well-fed sourdough mother.

This symbiotic care creates a specific rhythm in the baker's everyday life, resulting in bread and a form of self-care for the baker. Bakers can seek solitude and time through this collaboration with non-human others. The routine of taking care of the sourdough and baking from it becomes a form of meditation, a space to ground oneself, and a place of joy. Others use the slow pace of sourdough baking as a silent and personal protest of a fast-paced society where people are used to getting things done quickly and conveniently. The simple act of sourdough baking becomes an act of resistance to dominant temporalities. Such mutualistic practices of humans and non-humans help to structure time in a way that better serves the mutual needs of the bakers and sourdough mothers. This restructuring of time through collaborative practices demonstrates how human self-care and well-being are intricately bound up with the well-being of other species and the overall ecosystem. Furthermore, restructuring the experience of time through interspecies collaboration can perhaps nurture a new approach to sustainable living, where humans take the interests of other species into account when going about their daily business. To live well will thus mean to live well *with* other species.

By dipping one's hand in a bowl of sourdough, the baker can connect with the past, present, and future. A baker and his sourdough can travel together through life and co-exist within a joint timeline. While the baker slowly moves from one significant life event to another, matures, and gets older, the sourdough stays more or less the same, still slowly rising and falling. For bakers who've had the same sourdough as a travel companion for many years, the sourdough can act to connect to one's former self and emphasize one's outlook on life. The sourdough can even be a medium to travel through time and connect with family and people of the past through the microbial ancestry of the sourdough. A sourdough mother with a long linear history holds significance as it is contextualized socially and culturally as the giver or mother of bread. Sourdough can even be inherited and kept alive between generations, thereby repeatedly outliving human collaborators. The symbiotic care that the baker and the sourdough mother mutually participate in, often with the help of the family and friends of the bakers, can thereby stretch over centuries, where the sourdough mother is fed by a generation of bakers, attending and tuning into the rhythm of the sourdough. This is symbiotic collaboration and care through time as different com-

munities of microbes have co-evolved with human bakers and shaped their common history. For a long time, sharing sourdough mothers has been a part of multispecies commensality and community making. However, there is another side to this story: the microbes that the sourdough mother consists of have also been creating their own communities over time. To share sourdough mothers that, in turn, share human bakers illustrates symbiotic care in everyday life.

Notes

1 One of the authors of this article is the founder and admin of the Icelandic Sourdough. These numbers are through her data collection.

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Microbial Entanglements in the Bulgarian Cellar: Control, Collaboration, and Quiet Food Sovereignty

Lindsey Foltz
Independent Scholar
USA

Abstract
To save food for winter, domestic preserve makers in contemporary Bulgaria employ a variety of microbe management techniques including fermentation, sterilization, drying, and cold storage. This diversity is built upon micro and macro biocultural refugia significantly influenced by everyday life during state socialism, that persisted in the early post-socialist period and after European Union integration. I analyze microbial management techniques as social practices arguing they are manifestations of quiet food sovereignty. The resulting home-preserved foods are prized as clean, tasty, and reliable. They complement industrial foods in everyday life. This article is based on ethnographic research conducted between 2018–2021.

Keywords: food sovereignty; food preservation; food self-provisioning; biocultural conservation; Bulgaria; food studies; practice theory

While fermenting, drying, and jarring food for personal and familial consumption are marginal practices in most of Western Europe and North America, they are relatively common practices in post-socialist countries like Bulgaria (Alber and Kohler 2008; Jehlička, Kostelecký and Smith 2013; Rose and Tihomirov 1993). These everyday household strategies for "making do" and pursuing meaningful lives in these countries are tied to experiences of living under state socialism (Caldwell 2004; Shkodorova 2021). During socialist times people developed complex and multifaceted strategies to negotiate economies of shortage, secure basic material needs, and pursue something more than mere sustenance (Verdery 1996; Creed 1998; Drakulic 1993; Dunn 2004; Bren and Neuberger 2012). Gaining access to food, not only for survival, but also for celebrating, offering hospitality, supporting health, performing personal, local and/or national identity, and satisfying personal and familial desires and aesthetics required elaborate strategies, networks and skills. These strategies included the creation and maintenance of extensive social networks and a robust informal economy for everyday goods like food and clothing (Verdery 1996; Creed 1998; Ledeneva 1998). Home-preserved foods that were typically produced in rural areas circulated far beyond their rural origins; they traveled along networks of extended social relations in what Smollett referred to as the "economy of jars" (Smollett 1989).

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Today, neoliberal economies in formerly socialist countries retain many elements of the diverse economies (formal and informal) from the socialist past. Post-socialist foodways studies such as those of Caldwell (2004), Jung (2009, 2010, 2016, 2019), and Dunn (2004, 2010) demonstrate that while post 1989 entry into neoliberal global economies was a rupture with the centrally planned economy of the past, many of the everyday food related strategies, practices, and networks developed by Bulgarians and other socialist citizens continue to the present day. For example, many Bulgarians actively produce or gather a portion of their annual food supply through gardening, foraging, or tending small livestock and stock up for winter through home-based food preservation and storage. According to a September 2019 survey conducted by a popular Bulgarian news outlet, more than 70% of Bulgarian respondents made or consumed homemade preserves (news.bg 2019).

Food self-provisioning and preservation do not fit the timeline of progress for those who operate within a modernist, capitalist conceptualization of development (Kostov and Lingard 2002, 90; Alber and Kohler 2008, 113–27; Murton, Bavington and Dokis 2016). Because these practices are deeply entangled with industrially produced and globally sourced materials and preserve makers rarely articulate associations or motivations linked to social movements they may also not seem "progressive" through the lens of food-based social movements or public efforts to preserve traditions (Visser, et al. 2015; Yotova 2018). What gets lost in between these two conceptualizations is the emerging, evanescent present manifesting in living practices that draw on inherited, experimental, prototypical, and novel materials, competences, and meanings. Looking around in the present moment (rather than ahead or behind) I have endeavored to engage my "art of noticing" to the proximate and ordinary to better understand stability and change, and how "gatherings" of people, plants, animals, and microbes sometimes become "happenings" (Tsing 2015 12, 22–23). This informed both the method and analytical frame for this paper, which is based on participant observation, interviews, inventories of cellars accompanied by surveys (2018, 2019, 2021) and uses social practice theory as an analytic. Drawing from the multiplicity of social practice theories allows me to avoid a linear conceptualization of food systems development and reconceptualize food systems as contingently arranged practices, oriented in space and time. These practices have some stability, but they are also constantly shifting.

I conceptualize food preservation in Bulgarian households as social practices that condense in the cellar (Nicolini 2017; Schatzki 1996; Schatzki 2002; Shove, Pantzar and Watson 2012). Food preservation practices are intrinsically linked to other social practices relating to many aspects of everyday life such as shopping, gardening, gathering, cooking, and eating. Social practices are intentional, though often routinized, activities which consist of interconnected elements such as "[…] embodiment, physical objects, inner emotions, competences of how to do things, and motivations to do them" (Neuman 2019, 83). They are performed by carriers of the practices, and when they are performed, they are "[…] the routine accomplishment of what people take to be 'normal' ways of life" (Shove 2003, 117). Accordingly, social practices are performed "on the basis of what members learn from others, and are capable of being done well or badly, correctly or incorrectly" (Barnes 2001, 27). While individuals are carriers of

practices, what distinguishes personal idiosyncrasy or habit from social practice is that social practices are shared by a group of people. This means that these practices are necessarily recognizable and mutually referential. They are "collective possessions and accomplishments sustained through interaction and mutual adjustment among people" (Schatzki 2001, 6).

Practices are also "intrinsically connected to and interwoven with objects and non-human entities" (Shove, Pantzar and Watson 2012, 14). This makes social practice theory an ideal analytic for examining the inter-relationships of microbes and humans in terms of food preservation. To save food for winter, home-based preserve makers in contemporary Bulgaria employ a variety of microbe management techniques. Methods like fermentation could be characterized as multi-species collaborations that elongate the time-period of human edibility, protect or promote health, and appeal to human senses. These fermented products, however, sit side by side with foods that are preserved through water-bath jarring, which relies on sterilization to help preserve makers win the "race against rot" (Weiler et al. 2019). I also observed dried foods, pickled foods, and fresh storage of root crops and apples in cellars that I visited.

The diversity of methods employed by preserve makers demonstrate multi-faceted engagement with microbes that are part of their everyday foodways. Though this is true of all of us who engage in everyday food preparation, I was particularly intrigued by the persistence of these microbial management practices as they relate to home-preserved foods that, in the West, have largely been replaced by industrially produced alternatives.

The legacy of socialism continues to shape contemporary Bulgarian food preservation practices through elements of social practice: materials, competencies, and meanings. In the following sections I focus particularly on the durability of materials and competences that people draw from, including taste memories that people carry. The meanings of these foods have always been varied and overlapping and have also shifted over time as broader political and economic circumstances have changed. So, while the materials and competences have remained more stable, the meanings of home preserved food that people described to me are variable and volatile.

The realities of everyday life during state-socialism in Bulgaria contributed to the maintenance, and perhaps expansion, of a large community of practitioners competent and motivated to preserve food and equipped many households with the durable tools to do so. These domestic practices continued alongside the consolidation and industrialization of agricultural production and processing. In terms of food production, in the early years of state socialism formerly private agricultural land was nationalized and consolidated to form large "cooperative" farms (for Bulgarian examples see Creed 1998 and Cellarius 2004, for Polish example see Dunn 2004, for Hungarian example see Lampland 1995). This marked a major shift for socialist nations like Bulgaria from a primarily peasant based agricultural system to an extensive, mechanized, industrial form of agriculture. This style of agricultural production also had impacts on agricultural biodiversity, favoring crops suited to large scale, mechanized production that yielded a high economic impact. Domestic gardening practices continued in parallel, providing refuge for varieties of plants and animals that were not well-suited

to industrial production but that were valued by producers.

Following a similar path, food processing was nationalized and further industrialized by the state; brought into the webs of the centrally planned economy and Fordist production logic (Jung 2009). Microbes were also brought into the modernizing and industrial processes propagated by the socialist state. One example of this can be found by tracing the history of yogurt in Bulgaria. Efforts to standardize the strains of bacteria used to produce yogurt allowed for broader commercialized and industrialized production before state socialism, but this trend accelerated between 1945 and 1989 (Stoilova 2013, 73–92; Neuberger 2022, 97–99). Using home-made yogurt starters as a foundation, government researchers selected and then cultivated strains suited to industrial production which were then patented (Stoilova 2013, 73–92). These lab created "clear" strains were distributed to large scale milk processors (Stoilova 2014). These yogurt cultures, which are still available to buy, were referred to as *maya* by my interviewees. This was a general term they used to describe multiple microbial products such as yeast for baking bread, yogurt starter cultures, or cultures needed for making white cheese (*sirene*) all of which are readily available in most food shops to this day. However, like home gardens, domestic food preservation practices allowed people to negotiate the formal systems on their own terms. While scientists and the state were standardizing and homogenizing microbial cultures, at home many people continued to ferment with self-managed and propagated cultures.

As a result of the economies of shortage and as a way to negotiate the formal food market during socialism, many people in Bulgaria retained materials and competencies related to food production and preservation. These practices did not supplant the industrialized system but rather operated in entanglement with or parallel to it. These practices have created relatively unregulated pockets of biodiversity in terms of plants, animals, and microbes that have continued to be adaptive in a post-socialist context. They also provide an opportunity to retain food diversity from the perceived homogenizing influences of the European Union, with its common market and agricultural policies that generally favor large, industrial agriculture in Bulgaria (Ivanova et al. 2021).

For this research, I documented how people who engage in domestic food preservation ensure safety outside of a formalized environment, with no regulations and little in terms of precision instrumentation. My interviewees routinely identified sensorial skills and relationships of care as necessary to ensure that these unregulated, and sometimes illegal, foods were safe to eat. These foods provide an alternative to industrially produced and globally networked foods, even while sometimes integrating them as ingredients in home-preserved products. In a country where certifications and regulations were not always trusted, these home preserved foods provided a sense of security and safety. My findings were similar to those of Maria Yotova, who observed that Bulgarian consumers implicitly critique state and neoliberal regimes through their persistent valuation of the "goodness" of *domashna* (home-made) yogurt and ongoing production and exchange of homemade foods (2018). Beyond food security, these home-made and preserved foods promote food sovereignty and sit at a nexus of social practices preserving biocultural resources. Though again, not usually

in overt activism against or opposition to mass produced foods or the corporate industrial food regime (Holt-Gimenez and Shattuck 2011; Yotova 2018). Home preserved food is linked to resilience strategies that challenge state and supra-state entities directly and subvert them discretely through relationship management from the micro to the macro.

Saving Food in the Village of Mladen

August and September are especially busy months in Bulgaria when it comes to preserving food. A crush of garden, orchard, and forest products are ready for harvest during this time and preserve makers are in full swing. In this section I describe detailed scenes of everyday life at the end of summer that are emblematic of routine practices carried out by many Bulgarian families. I focus on one extended family who live and work in two cities just north of the Balkan Mountains. During the summer they spend a good deal of time in their familial village called Mladen. I visited Mladen several times over the years (in 2008, 2018, 2019, and 2021), most often in late summer. On these trips to the village, I joined in multi-generational family gatherings, including the oldest family member who was a fulltime village resident. I spent time in their gardens, the nearby forests, and vineyards. While many foods along with wine and brandy were preserved in the village, they were also mobile, travelling in jars and bottles to urban cupboards.

It was a crisp, early fall morning when I arrived in the village of Mladen in 2019 with my friends Irina and Tihomir along with their daughter Zhuzhi. I hadn't been there for 11 years, but as I pushed through the garden gate it was still very familiar. Tatyana, Irina's mother, welcomed me back to her family's village home with a hug and kisses. Her father was a medical doctor, and he built this house in 1923. It was constructed of stone, wood and plaster and had a large, enclosed yard. There were fruit trees, a line of beehives underneath them, a substantial vegetable garden, flower beds, several long rows of grape vines, and two grassy enclosed areas separated by low rock walls.

Figure 1. Photography by the author.

She walked me around the yard, narrating as she showed me various plants and buildings and recalling her childhood days. As Tatyana and I finished our tour of the yard she led me over to a grassy area fenced off by a low rock wall. There we found Irina and Tihomir along with Tatyana's husband Andree, cousins Stefan and Nadezhda, and her uncle Petar deeply engrossed in their big project for the day, distilling plum *rakiya* (brandy). Making the *rakiya* blended a good deal of leisure and socializing into the more laborious tasks at hand so there was plenty of time for chatting and taking pictures.

Figure 2. Photography by the author.

As was common with other interviewees, while engaging in preservation practices everyone shared memories from the past. In this case, the conversation turned to both positive aspects of socialist times such as a robust manufacturing economy as well as the darker legacies, which for Tatyana's family included the killing of her grandfather and displacement of her grandmother, aunt, and mother. The older generations also compared and contrasted the necessity of making jars during socialist times with the contemporary situation. While in the past the problem was insufficient quality or quantity of industrially produced foods, today there were concerns over low wages and pensions, quality control, healthfulness, and aesthetics. Though the political and economic regimes were very different, some of the outcomes were the same: feelings of precarity, a strong desire to hedge against uncertainty through domestic production, and seeking pleasure and meaning outside of consumer-based pursuits.

When I asked Andree why he made *rakiya* he turned to face me with wide eyes, threw up his hands and exclaimed with a laugh, "What am I supposed to do, throw away the plums?" They indeed had several plum trees in the yard; plums thrive in this region, and it is famous for plum production. They all ripen at roughly the same time and spoil quickly. While Tatyana coated many plum slices in sugar syrup and dried them and made jarred compote and jam, the sheer volume of plums easily outstripped the family's capacity to preserve them in these ways. *Rakiya* used hundreds of gallons of plums and preserved them in the form of long-storing alcohol. The highly perishable plums provided a time sensitive reason for multiple generations to gather in the village to preserve them quickly before they rot. These diverse preservation methods

are emblematic of very different ways of managing microbes from collaborative fermentation to sterilization.

Stefan and Nadezhda lived and worked in Sevlievo, they usually visited Malden on the weekends to spend time with Petar and help with the gardening and preserve making. Petar was the only one of the extended family who lived full time in Mladen; rather lonely since his wife passed away a couple of years before.

Figure 3. Photograph by the author.

On this day, the family gathered around the large copper still (*kazan).* When it was open, the large bottom portion of the *kazan* resembled a giant cauldron, and the men filled it with fermented plum mash. The copper *kazan* was composed of three large pieces: the bottom piece, a slightly smaller top cap, and a pipe for the steam to travel through to the condenser. This meant that there were three seams where the metal pieces fit together. Petar demonstrated to me how he used flour and water to create a dough that he then deftly rolled in his hands, forming a long rope. He took this dough rope and pressed it along the seams of the pieces of the *kazan* to stick them together.

As the *kazan* heated up, the dough cooked and hardened which created an airtight seal. "It's a Bulgarian gasket" Stefan joked. The large copper *kazan* was charred black on the outside from sitting on top of cement blocks over a roaring wood fire. Long branches fed the fire; the men periodically pushed them under the *kazan* as the wood burned down. This saved the step of chopping the wood. As the fire burned down, there was an accumulating pile of thick gray ashes and hot coals between the cement blocks.

Though this was distillation day, the process for making the *rakiya* started a few weeks prior. The family picked and lightly smashed the plums and then put them into 50-gallon plastic vats to ferment for 14 days. Andree took me down to see the vats of fermenting plums. They were kept down a short staircase in a stone cellar, filled with a slightly sour yeasty smell and thousands of fruit flies, hovering low over the fruit. Andree told me that these flies were an essential part of the fermentation process. These non-human collaborators helped to move the yeast around in the barrel. The stone cellar provided a relatively constant, cooler temperature that was ideal for fermenting. In the quiet of the cellar the fermenting barrels would give off a quiet fizzing sound at about the one-week mark. Andree explained that sometimes he had to add sugar at this point if the mash was not fermenting quickly enough which he could judge by

Figure 4. Photograph by the author.

smell and consistency, but otherwise it was just natural fermentation. After two weeks the fermented plum mash could be distilled.

Though this was a male dominated task, Nadezhda also took turns feeding the fire and monitoring the still. She joked about being a woman involved in *rakiya* making by feminizing the word for "*rakiya* master" and conferring the title on herself, which everyone chuckled about. Though clearly familiar with the process, and involved in several of the tasks, the women would always defer to the men when I asked questions about making *rakiya.* The opposite was true when it came to preserving food. Even though both men and women participated, the women were the ones who were considered the experts. These idealized gendered divisions of labor, with men responsible for alcohol and women responsible for food, was also reflected in how consumers of these products described and remembered them. For example, people would refer to their grandmother's or their mother's jam and their grandfather's or their father's *rakiya* and wine.

This batch of *rakiya* was finished when no more liquid came out of the condenser into the little bucket positioned underneath the spigot. Nadezhda monitored this and let everyone know when it stopped dripping. Then the men gathered again to pull the charcoal and ashes out from the firepit and let the *kazan* cool.

This took at least an hour. Once it was cool enough to safely handle, they broke the dough

Figure 5. Photography by the author.

Figure 6. Photograph by the author.

seams, and removed the pipe and lid. The bottom part contained the cooked-down plum sludge. Wearing heavy work-gloves, Stefan carefully scooped out the still steaming remnants with a bucket and threw it over the wall into the garden area. "This will work like a compost" he explained as he distributed it over the ground.

Once empty, the three men washed every part of the *kazan* and carefully scraped off the remaining bits of dough along the seams. They then re-filled the *kazan* with fermented plum mash, sealed it with fresh dough, and started a new fire.

There were moments of intense activity distilling the *rakiya*, but there were also long periods of down time, like waiting for the *kazan* to cool off. I listened to stories that came up as the family worked together and used quiet moments to ask questions about the processes. Each person had little side projects going on in their houses and gardens; they would toggle back and forth as needed.

During one of these downtimes Nadezhda showed me around Uncle Petar's cellar where she had filled many boxes with home-made preserves in jars. She used water-bath canning to put up shelf-stable tomatoes, jams, fruit compote, and cucumber pickles. While Nadezhda showed me around she told me that her mother-in-law, Uncle Petar's late wife, was the one who taught her how to make preserves. Nadezhda spoke of her mother-in-law with great fondness.

While in the cellar I recorded Nadezhda's recipe for *lyutenitsa*, a savory pepper and tomato relish, which she recited to me while holding a small ruby red jar of the most recent batch:

> Take about 10 kilograms of tomatoes. You mill them, removing the skins and the seeds, and then you begin boiling the tomato juice until it becomes a thick puree. After this it will be almost as thick as the finished product. You have to roast 10 kilograms of peppers. You remove the skins and clean off all the seeds. After this you put them through

> a meat-grinder. In the same way you take eggplants, 2 or 3 kilograms. Again, you roast them, peel them and grind them. If you want you can also add a little bit of carrots, grated. All of this you start to boil until it is a thick puree. You season it with salt, sugar, and oil. Some people put in black pepper to taste, and you boil it until it is thickened. May it be sweet to you all winter long!

In addition to jarring foods through sterilization, Nadezhda also fermented her own yogurt.[1] She sourced the milk from *poznati* which means someone who she knew personally and had a relationship with. This woman kept a cow and sold a little milk informally. The women I interviewed who made their own yogurt all told me that they bought milk from *poznati.* As another woman named Vasi told me, she only bought milk from *poznati* because, "You know they won't sell you something bad or that will make you sick […] you know each other and they will take care of you." Nadezhda showed me the small, enamel covered pot she used for making her yogurt. The milk must have been very rich because the yogurt had a thick layer of solid cream on top. Nadezhda fed me a large spoonful and it had a pleasant, mild sourness and a slightly animal taste. She said that you can buy starter (*maya*) for yogurt or just start the next batch with some yogurt from the previous batch mixed in with new milk.

Though occasionally people I interviewed would name specific strains of cultures, for example *lactobacillus Bulgaricus*, generally preserve makers like Nadezhda would focus on the "how" of making preserves, rather than the specific biological mechanisms that preserved food. This may be an artifact of speaking with me, an obvious foreigner and non-native speaker. However, even when sharing recipes with other novice preserve makers who were Bulgarian, I never heard anyone articulate the detail of the biological processes or name the specific microbes. The microbial management instruction focused on a description of the ingredients, process, and sensorial indicators.

My friend Irina (Nadezhda's niece) later confided to me that she didn't really like homemade yogurt because it had a stronger taste than the store-bought kind. She ate that instead even when homemade yogurt was available. Industrially produced Bulgarian yogurt is widely available and affordable throughout the country from small shops to large supermarkets. Nadezhda commented that she also bought this industrially produced, commercial yogurt from time to time. But she had access to raw milk from a small producer and the knowledge about how to make it herself as well. She preferred the taste and texture of home-made and knew exactly what went into the yogurt when she made it herself. However, these various ways of getting yogurt were not framed as oppositional. Nadezhda had choices about how and when she opted for home-made versus commercial yogurt and when she used her own yogurt cultures or when she bought *maya* (starter cultures) from the store.

Like Nadezhda, Tatyana also made yogurt at her village house and bought the milk from *poznati*. She noted that the village of Mladen had a long history of dairying: "In terms of milk products there was exceptional and healthy milk and *sirene* [similar to feta cheese], *katuk* [thick fermented milk inoculated with *sirene*]." I commented that I thought *katuk* was very tasty. "That *katuk* is not the same as my grandmother's. I re-

member. The tastes you remember" she emphasized by pointing her index finger to her head. "There is a memory for taste, there is a memory for smell. My grandmother would make it in a *delva*. Do you know what a *delva* is? It is a vessel made of clay. On that shelf in the basement, like that one right there in the corner. Inside was yogurt and *sirene* that was put into it. Crushed into it. But you have to crush the *sirene* into it [by hand]. Now the process is too fast." *Katuk* is commercially available in grocery stores and is served in restaurants where I had eaten it, but Tatyana did not think that was authentic. She emphasized that the product labeled *katuk* did not match her embodied taste memories. She was adamant that the process needed to be done by hand, fermented slowly, and made in a clay pot so that it would taste right and constitute "real" *katuk*.

Tatyana also let me visit her cellar. As we began the tour of the year's jarred preserves, Tatyana reminded me that this represented only a portion of her work. Some jars were already in the nearby city of Gabrovo at her apartment and also in her daughter Irina's pantry. She opened the old wooden doors of her grandmother's bureau. Inside the bureau were lines of small jars containing "the sweet things" that she had made for the year and tomatoes.

She narrated the contents of the jars by sight, nothing was labeled. "Here we have tomatoes, cut and pureed. All the sweet things, figs, raspberries, apricots, quince." She picked up a jar to inspect it in the light, "Are these blackberries?" she asked herself. "No, sour cherries [*vishni*]" she decided. There was also wild strawberry jam and a mix of wild strawberries and raspberries. She told me that she didn't use pectin to thicken her jams but just cooked them down slowly with sugar. Some of the jars were recycled Gerber baby food jars that she had got from a friend who saved them recently. She also had baby food jars from when her granddaughter Zhuzhi was little and they would get baby food from the "Milk Kitchen" in Gabrovo. These were slightly larger than the Gerber jars but also with a screw cap. Moving along the shelf I pointed to a jar, "What is this?" I asked, "syrup?" "It must be, yes" she said, picking up the bottle and tipping it in the light to get a better look. "Well, maybe jelly from blackberry because it is very dark or maybe from sour cherries." Then she pointed out another row of jars, "Zhuzhi likes jam from only raspberry, so I make that, too."

Like many preserve makers, Tatyana adjusted her preserve making to suit the tastes and desires of her family. There are many ways that the practice of preserve making creates connections among people. As other scholars have noted, preserved foods circulate in and create social networks (Smollett 1989). They can be given away as gifts to maintain ongoing relationships and are a way that people can demonstrate care for their family by customizing preserves to their tastes or needs. As Tatyana demonstrated, this could take the form of making raspberry jam specifically for a grandchild or sending adult children large quantities of a variety of preserves for their everyday use. They provide a significant source of homemade foods across generations which creates alternatives to commercially produced, purchased foods. Preserve makers often expressed pride in having something good to give their friends and relatives, things that couldn't be bought in a store not because of the saved expense but because of the high quality, personal customization, and superior taste. In this way

Figure 7. Photograph by the author.

these preserved foods encapsulated care and love, packaged up in portable jars.

She moved to another bureau that was three-quarters full of clean, empty jars. The full jars in this cupboard included *turshia* for which Tatyana recited this recipe, "I made this *turshia* from *kambi* (a small, round sweet pepper), carrots, *tselina* (celeriac), garlic, vinegar, salt and sugar. I always put in a little sugar." There were also some small jars of preserved cherry tomatoes. She continued through this cupboard pointing out short, squat jars containing mixed vegetables including okra. I commented that I very rarely saw okra and asked if she grew it in her garden. "No" she said, "I bought it." She agreed that okra was becoming rarer. So, she gave me the basic ingredient list, aside from the okra, "green beans, blue tomatoes or *patladjan* [eggplant], carrots, peppers, tomatoes."

She used this jarred, stewed vegetable mix to make the final dish called *gyuvech* in the winter. "*Gyuvech* is a dish that you make from sliced potatoes and on top of the potatoes you put this" she said as she pointed to the jar she was holding in her hand. "You mix in the vegetables, and bake it, with a little oil and red pepper. You use a middle-sized pan about like this" she said holding up her hands to show about a 9 x 13-inch size. "For that size you use two jars. You add a little water, red pepper, and

Figure 8. Photograph by the author.

oil and that's it. You can also add salt." These types of partially prepared foods were common in many cellars. They reduced kitchen work during the winter and provided a pop of color on the winter table. Often people remarked that these types of preserves were "a taste of summer in the winter."

She then showed me a jar with whole sweet peppers mixed with carrots and cabbage. The jars were so colorful I asked if I could take her picture with them. "Of course! Take pictures!" she said. So we headed up a couple of stairs and out to the better lighting of the patio.

We went back into the cellar to continue the tour, "There are plums [*slivi*] but also yellow, wild plums [*djanki*]." There were quite a few of these trees in the yard. She had also jarred many cornelian cherries [*drenki*] but she said that she had given all those jars to daughter Irina and son in law Tihomir so she didn't have any there in Mladen.

Moving on, she pulled out a small jar with a screw-top cap, "These are hot peppers for Andree from last year." Inside the jar was a mix of small, green and red spicy peppers, mixed with whole garlic cloves, black peppercorns, parsley and celeriac leaves, floating in vinegar. Tatyana wrinkled her nose, explaining that she didn't like spicy things at all, but Andree wanted her to make these for him. Tatyana went on, "I like [sweet] red pepper a lot. But spicy peppers, no!" At this point Andree chimed in to say that he ate the spicy peppers as a "treatment," and that eating them kept him healthy. They grew a small bush of spicy peppers in a pot just for him for these purposes. This marked them as important "functional foods" that were not consumed for a basic nutrition or particular medical cure but for general health promotion benefits (Pieroni and Price 2006, 108–10).

Material links to the socialist period are found in tools, jars and the varieties of fruits and vegetables popularized during those years (like Gumza grapes or Kurtovska Kapiya hybrid peppers). Though there were some materials like older wooden barrels or clay pots that were used in the more distant past, these were not typically being used in contemporary preservation practices. What were used and re-used were glass

Figure 9. Photography by the author.

jars, metal cooking pots, food mills, and firepits. Women like Tatyana and Nadezhda learned to make jars during socialism. However, because they were working and had small children their mothers and mothers' in-law tended to make the bulk of the jars for the family. They carry on this tradition for their now working-aged children. They all described personal histories related to the development of sensorial skills required to make preserved foods and to judge their goodness that were passed on directly from generation to generation.

Throughout all my visits to Mladen, Tatyana took the chance to explain various things to her granddaughter Zhuzhi and share family history associated with particular foods and preservation tools. Much to Tatyana's distress, her granddaughter was not nearly as interested in learning these things as I was. In any case, Tatyana was literally putting a taste of the village and home-preserved foods in her granddaughter's mouth for future recollection. This may be drawn on later by the younger generations in judging goodness through embodied taste memories. Tatyana's daughter Irina was also episodically involved in many parts of the preserve making process, including gardening, foraging, jarring, and drying. Though because of the time constraints of being a working mother her production was limited, she was in the process of developing many competences in food-self-provisioning and microbe management which she could draw on in the future if she so desires.

Growing and preserving food is very labor intensive and there were times when Tatyana would express frustration at being tied to the garden. But this work was also

interspersed with more pleasurable activities like visiting and eating with neighbors and friends and spending time outside in the fresh air away from the grind of city life.

Though there was a lot of work being done on this day everyone stopped to gather around the table packed with salads, stuffed cabbage, grilled meats, cheese, bread, yogurt, soft drinks wine and *rakiya*. We started with garden fresh salad containing cucumbers, tomatoes, finely minced onions, and parsley. This was accompanied by small glasses of *raikya* and several rounds of toasting. The homemade foods and alcohol were a point of pride. This was demonstrated when people pointed out each dish on a table that was home-grown or homemade (*domashna*), and also by comments like, "you can't buy anything like this in a store." But even these homemade and home-preserved foods were intertwined unabashedly with industrial (and sometimes global) food chains including the sugar and spices that went into jarred foods.

After eating and drinking our way through the merry, multi-course lunch including dessert and coffee we all went back out in the yard and gathered to say our goodbyes. While I got one last look at the distillation process, Nadezhda asked me if we make *rakiya* in the U.S. I told her that my dad makes wine but doesn't make brandy because it is illegal to make strong alcohol. At this everyone in the yard burst into laughter. Nadezhda replied, "Of course it is illegal to make it here too, but everybody does it."

Microbial Management and Quiet Food Sovereignty

In domestic food preservation microbial management is handled at close range, often by the same people who are the end consumers of the preserved foods. These preserve makers have a wide variety of embodied skills and knowledge about how to safely preserve foods through lactic acid fermentation, acetic acid pickling, water-bath sterilization, and drying foods for winter. The end consumers also rely on embodied memories of taste and smell to sense and judge the goodness of home-preserved foods and if they are safe to eat. Preserve makers and consumers train their senses through exposure; feeling the temperature of the milk before adding the yogurt starter, referring to taste memories or smells to determine if things like fermented cabbage are still good for eating. In addition to the senses, people rely on relationships of trust, care, and competence to ensure their home-preserved foods are safe. People trust raw ingredients, like milk, and finished goods, like jarred foods, that are produced by people they know. They feel confident that people with whom they have relationships would not cut corners or take risks with the end consumer's health and that they are highly skilled.

In contrast, industrially produced foods available in formal markets rely on standardized and regulated processes to make foods safe and things like labels and certifications to communicate their quality to consumers. Discerning good food rarely relies on the senses but relies more on understanding, interpreting, and trusting certifications, knowing how to read labels, etc. This can be challenging in a country where there is widespread mistrust of both government regulators and corporations. Though as Jung put it, people in Bulgaria are learning how to be "canny consumers"

of industrially produced foods and do increasingly integrate these foods into their everyday foodways (2009).

In terms of biocultural conservation related to home-based food preservation, the socialist period was significant because of the co-occurrence of industrialization of agriculture and food processing with the retention of small-scale subsistence plots and domestic food preservation. This means that Bulgaria, unlike many Western nations, had no break in the extensive practice of subsistence production and household level self-provisioning and preservation even within an industrialized, international food system. Biological diversity preservation (wild and domestic) and cultural preservation of diverse foodways and traditional ecological knowledge are a significant result of this historical context.

A wide array of materials and methods for managing microbes were therefore preserved and continue to the present day. This includes the knowledge of how to make fermented foods like yogurt by adding microbial cultures to yogurt, lactic acid fermented cabbage in brine and the vessels and cellars within which to do so. This also includes ready access to jars and the skill to put up a wide variety of fruits, vegetables, and meats for winter through water-bath canning. These jars have the advantage of being portable and circulate widely which continues to re-create social relationships of care and maintains a knowledgeable consumer base with embodied taste memories. Many people in Bulgaria also still have familial connections to gardens and orchards which provide a seasonal surplus to be available for preserving, like the hundreds of gallons of plums needed to make *rakia* through a combination of fermentation and distillation.

As multiple generations often gather, at least episodically, to help with large tasks like roasting peppers, harvesting grapes, or distilling alcohol these cultural practices and embodied skills are passed on. This has only been amplified by wide access to technology like smart phones, which have enabled many people to self-document many traditional food preservation practices and distribute them through mediums like YouTube. Some young people described to me using a combination of things like old family recipes, YouTube videos, and embodied taste memories to re-create preserves for themselves, even when the intergenerational transmission in their families had been broken. Access to raw ingredients and equipment, widespread knowledge, and finally time and space to make these home preserved foods create an important niche in Bulgaria for biocultural conservation which has provided both historical and contemporary resilience.

I argue that household-oriented gardens, small farms and wildlands that provide most of the raw materials for home-preserved foods in Bulgaria are biocultural refugia, "physical places that not only shelter farm biodiversity, but also carry knowledge and experiences about practical management of how to produce food while stewarding biodiversity and ecosystem services" (Barthel 2013). I think this concept can be usefully translated from the scale of the landscape to the scale of the yogurt pot or fermentation barrel. They are microcosms of diversity made in collaboration between humans and their more than human counterparts from fruit flies to bacteria and yeast. In fact, even sterilized jarred foods represent refugia and the social networks created

by their circulation support refugia at both macro and micro scales. Barthel et. al argue that *biocultural refugia* contain knowledge, practices, and beliefs relevant to increasing food production, reducing biodiversity loss, and maintaining diverse and ecologically well-adapted practices (2013). I propose that these biocultural refugia both micro and macro, and the foodways that are built upon and within them, are the manifestation of vernacular food sovereignty practices distinct to a post-socialist context that Eastern European food scholars have articulated as "quiet food sovereignty" (Visser et al. 2015, 527–28).

Food sovereignty is a term that was originally coined by members of La Via Campesina, an international peasant movement, in 1996. Though the definition has evolved over time, it is currently defined as, "The right of peoples to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems" (Nyeleni Agreement 2007). The concept is now used as a platform for participants across multiple geographies to organize and activate for food and food systems that are healthy, just, and locally determined. Food Sovereignty runs counter to the highly capitalized, industrialized, globally networked food system described by McMichael as the "corporate food regime" (2005). The creation of "Alternative Food Networks" (AFNs) or other activism to promote Food Sovereignty are ways to resist and circumvent the ubiquity of the "corporate food regime" by expanding food production and acquisition capacity outside of industrialized, corporate agriculture (Holt-Gimenez and Shattuck 2011; Wittman, Desmarais and Wiebe 2010; Goodman, DuPuis and Goodman 2012). As Wilson puts it, "AFNs are ideas and actions that in some way subvert or contest industrial capitalist foodways, such as urban farming, Community Supported Agriculture, agroecology, fair trade and so on, while continuing to work within its interstices. Similarly, Food Sovereignty emerged as a concept in activist circles (and only later in academia and policy) to describe the project of carving out separate or at least partially autonomous spaces for the production, exchange, and consumption of food" (Wilson 2017, 1).

Home-based food provisioning and preservation in Bulgaria provides a significant amount of food as an alternative to the corporate industrial food regime, while not confronting it directly or seeking to remove reliance on it. This frames home-based food preservation as a practice based in desire and self-determination, although sometimes within constrained choices. In Western Europe and the United States these practices are often framed as "alternative" but are fairly common in Russia and Eastern Europe (Alber and Kohler 2008; Shkodorova 2021; Grivins 2016; Jehlička and Daněk 2017; Acheson 2007). This leads scholars such as Jehlička et al. (2020) to contest the use of terms like "Alternative Food Networks" since it frames industrialized, capitalized, globalized foodways as the norm and alternatives in an oppositional relationship with that norm. In Russian and Eastern Europe, they argue, these "alternatives" are actually mainstream and are not necessarily oppositional to, but rather interconnected with, industrialized, capitalized, global foods. The food sovereignty created through ongoing practices of food self-provisioning and preservation is therefore "quiet" in that it is not associated with a social movement and is not framed in opposition to the corporate food regime.

My observations mirror these findings. Self-provisioning and food preservation were common practices for many families and not typically associated with a social movement. It was clear that for many people the ongoing production of preserved food simply seemed like an ordinary thing to do, was reliant on familial and natural rhythms, and relationships of trust and care reinforced by robust informal food networks. It was a relatively mundane, routinized activity intermingled with a wide range of food provisioning practices including the purchase of globally sourced, industrially produced foods.

The pervasiveness of these food preservation practices has in fact created significant opportunities for people to negotiate the corporate industrial food regime on their own terms. People like Nadezhda can choose when and how to engage with those systems by buying industrially produced yogurt in the corner shop when she wants to. She also has access to the materials to produce her own, has the competence to ferment the milk into yogurt, and the desire to do so for aesthetic and health reasons. This ability to preserve her own yogurt is deeply relational and involves managing microbes at many steps along the way. It relies on human/cow relationships of care to produce the milk. This means that the owner must properly care for cow, make sure to carefully clean the udders and their hands before milking, and store the raw milk in a way that prevents an abundance of microbial life that would cause human sickness. There are then the human relationships of trust that facilitate the buying of raw milk. Then the yogurt maker has to heat the milk to a temperature to kill harmful bacteria and introduce selective strains of bacteria to make yogurt. In this case, that homemade yogurt was then eaten together in a multi-generational human gathering. In other words, the yogurt is intertwined with commensality at multiple scales and making kin within and across species boundaries (Haraway 2016, 71–72). However, it is important not to romanticize. Domestic food preservation is not only about collaborating with microbes in fermentive relationships of life but also about how human control of microbes, including systematic sterilization, are part of the cycle. Living and dying are entangled, and relationality is unavoidable (Haraway 2016, 38).

By "Thinking Food Like an East European," I argue that home-based food preservation practices in Bulgaria constitute "quiet" food sovereignty that is based on micro and macro biocultural refugia (Jehlička et al. 2020). As such, these practices offer important insights for thinking about interventions to change or preserve foodways that support hopeful, meaningful, and resilient food futures, and contribute to the burgeoning literature articulating "multiple" diverse food sovereignties (Wilson 2017; Kurtz 2015). This quiet sovereignty involves knowledge, ability, and desire to manage microbial relationships to human benefit including collaboration, manipulation, and control depending on context and result in foods that are prized as clean and reliable alternatives to industrial food, tastes of home and the village, and essential components in both everyday and ritual life.

Notes

1 For historical context on the significance of yogurt in Bulgaria see Stoilova 2013 and 2015 and Neuberger 2022.

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Fermented Living: Challenges in Adopting a Fermented Dietary Regime and the Role of Food Memories in Acquiring New Tastes

Áki Guðni Karlsson
University of Iceland

Bryndís Eva Birgisdóttir
University of Iceland

Jón Þór Pétursson
University of Iceland

Abstract
Our predisposition to adopt new dietary norms is both personal and intimately connected with our current life situation and our life-story, not least childhood experiences of food. The article describes the challenges, including health concerns, encountered by participants while adopting a fermented diet, in the context of an eight-week dietary intervention study, organized by the researchers. It also describes how memories and experience helped them overcome those challenges and adapt to the new diet. Based on qualitative interviews with seventeen participants in the study, selected at random; the article describes the frustration of not meeting expectations but equally the joy when things work out and we are able to overcome the challenges.

Keywords: diet; fermented foods; health; food memories; food taste

Finding a solid footing when faced with dietary choices in everyday life can be a daunting task. We face a variety of challenges when trying to make informed choices about the food we eat. These include availability, pricing and selection, but also our own personal inhibitions, tastes and health concerns. This article is based on interviews with participants in a food intervention study (see e.g. Welch et al., 2011). During the intervention, the participants were required to increase significantly the amount of fermented food consumed. In what follows, we will discuss the challenges that people encountered, and the strategies they deployed, which they discussed with our researchers in semi-structured interviews (cfr. Hopf 2004; Roulston 2018). They indicated that the everyday dietary choices that they made were informed by various factors, including their current life situation and personal history, as well as what we may broadly refer to as culture. Participants were randomly selected for this food intervention study, using a mixed methodology, dietary intervention research on

Cultural Analysis 22.2 (2024): 117–135

the effects of fermented food consumption, combining analysis of biological samples, quantitative surveys, participants' food journals and qualitative interviews, involving 97 participants, aged between 50 and 70 years, divided into four groups. Over 90% of the participants volunteered after seeing an advertisement on social media identified themselves as women.

Group 1	Group 2	Group 3	Group 4
Food intervention group	**Supplement group**	**Control group**	**Experienced control group**
3 sets of biosamples Interviews	3 sets of biosamples No interviews	3 sets of biosamples No interviews	1 set of biosamples Interviews and participant observation
Compliance survey	Compliance survey	Compliance survey	
Food diary	Food diary	Food diary	Food diary

Figure 1. The four research groups.

As outlined in previous research by Stiemsma et al. (2020), Crowder et al. (2023), Wilburn et al. (2017) and van Hylckama Vlieg et al. (2011), specific studies and scientific reviews suggest that consumption of fermented foods, including living cultures, may affect human health in statistically significant ways, as it increases the diversity of the gut microbiota and seems to decrease inflammation markers (Wastyk et al. 2021).

Research designs using a mixed methods approach, combining laboratory work with quantitative surveys and qualitative methods (semi-structured interviews and participant observations), have been successfully deployed to engage with in real life (as opposed to laboratory) research contexts, as demonstrated in e.g. Nyirenda et al. (2020) on community engagement in biomedical research. In our case, the aim of this intervention was to investigate the effects of 1) increased consumption of fermented food, and 2) the daily intake of a new probiotic supplement with fermented bovine colostrum (the first milk produced by cows after giving birth), over a period of 8 weeks, measuring changes in the composition of the intestinal and skin microbiome, metabolic related markers, inflammatory factors and metabolomic patterns. The purpose of this research project is to study the effects of a probiotic diet on the gut flora in a real-life context. Quantitative surveys were included to measure participants' compliance with the premise of the intervention.

This article is based on the analysis of a set of 17 qualitative interviews with participants in "group 1" (above) that form part of the data collected during this study. Our main questions are: What were the challenges and health concerns that participants in the dietary intervention encountered when aiming for an increase in their consumption of fermented food? What strategies did they adopt to overcome those challenges? How did experience and childhood memories help participants adapt to the new dietary regime?

The Dietary Intervention Study

This article is based on 17 semi-structured interviews conducted in the winter of 2022/23 with some of the participants in the fermented foods group ("group 1" in the figure above) of the dietary intervention study, investigating the effects of fermented food and supplements on health and wellbeing.[1] All of the participants were 50 to 70-year-old Icelanders who had shown interest in an advertisement we published on Facebook, on the study website, and shared on several mailing lists. Volunteers were asked to submit their contact details on the study website hosted by the University of Iceland. A letter describing the study informed volunteers whether they met the eligibility criteria, and after a short telephone interview, the participants, if selected, signed an informed consent document. Before the intervention period began, the participants were asked to fill in surveys and several biological samples were collected to establish a statistical baseline to compare with samples collected at regular intervals during the study period of 8 weeks. Each participant was then randomly (using SPSS randomization software) assigned to one of three groups: the fermented food group, a food supplement group, and a control group. A fourth group consisted of hand-picked participants with many years of experience working with fermented foods. These participants constituted a second control group. The research was conducted according to Good Clinical Practices (GCP; see the European Medicines Agency, n.d.) with each participant assigned a number to ensure their anonymity and privacy.

The primary objective of the research was to investigate the impact of consuming fermented foods or food supplements on health indicators, measured as the composition of the intestinal microbiota (feces/skin), nutritional and immune status as well as metabolomic factors (metabolites found in blood samples), physical ailments of the digestive tract and general physical and mental wellness (based on survey data) over an 8-week period. The survey included general background and lifestyle factors such as age, height, weight, physical activity, sleep habits, education, and occupation.

The food supplement was a capsule of fermented freeze-dried bovine colostrum with added probiotic microbes taken twice a day over a period of eight weeks. No interviews were conducted with these participants or the control group. The participants in the food intervention group were asked to increase their intake of fermented food from two portions or less per day, to six portions or more, over an eight-week period. This could be done through eating fermented vegetables, fermented milk products (instead of any unfermented milk), sourdough bread (instead of their usual bread/cracker intake) and/or kombucha which was suggested as a replacement for some of their daily coffee or tea. They were free to combine these at will or even skip one or two types. They received recipes, as well as instructional videos on how to make fermented vegetables, fermented dairy, sourdough bread, and kombucha at home, and they were offered enrollment in a live fermentation cooking class. Participants were also told they could buy ready-made fermented foods from the supermarket and were provided with a shopping list of suggestions. Finally, they were offered consultation with a dietitian at any point during the intervention period.

The researchers could monitor the consumption of fermented food through compliance questionnaires sent to the participants each week, as well as through a three-day food diary at the beginning of the intervention period, at four weeks and eight weeks—always using the same three days (either Thursday, Friday and Saturday; or Sunday, Monday and Tuesday). In addition, we collected information on overall food intake using a short Food Frequency Questionnaire (FFQ) based on a standard Icelandic database of 1200 commonly available food types (ÍSGEM).

The information that the participants were given on fermented foods was in the form of general written information, recipes, and instructional videos on the making of fermented food at home; all published in a closed Facebook group created for the study. The participants also used this group to exchange experience with fermentation and advice with one another, and to ask questions of the researchers. The participants were, moreover, encouraged to send emails to the researchers to book a personalized interview with a nutritionist to discuss their diet during the study, and how to incorporate more fermented food into their daily food consumption.

During the registration process, participants were asked to indicate whether they would be available for an interview toward the end of the intervention period, and almost all of them were. When the period was almost finished, we contacted over half of the participants in the food intervention group and conducted 30-to-60-minute interviews with 17 participants selected at random, focusing on their experience participating in the study, how they felt about their change in diet, and the challenges they met during the study. The following analyses are based on these interviews as transcribed by the researchers. Direct quotes have been translated from the original Icelandic by the authors of this article.

Challenges and Strategies

Most of the participants interviewed were open to sharing details about their participation in the study. The challenges they met with were mainly related to the number of portions, time, taste, food availability, lack of experience with making fermented food, and the reactions of others to their new diet. However, in many cases, participants found effective and innovative solutions to these challenges. Just over half of the interviewees made part of the fermented foods they consumed at home during the study period, while almost half of them purchased everything and did not experiment with making fermented foods at home.

Each participant was asked to consume six portions of fermented foods per day. However, the interviews indicated that they really managed to consume between four and five portions per day. They found the six-portion mark harder to hit than they (or we) realized before the study began.

Many participants were enthusiastic about the study but were hesitant about making their own fermented food to begin with. Most of them started by focusing on one thing, such as baking with sourdough, for example. Often this meant going back in time to something they had tried many years or decades earlier, and most said they were happy to have found their way back to an old habit. Others were happy to try

out something new and exciting.

The difficulties the participants found in making fermented foods were quite varied. Many of them described sourdough baking as complicated and difficult, while others had a good relationship with the sourdough ("It's the easiest thing in the world, to make sourdough bread"). For some, kombucha was something unknown and complicated to prepare, and the same was reported regarding fermented vegetables. Others found the home-fermentation process easy for both vegetables and milk.

A few participants discovered that kombucha can be an excellent alternative to drinking coffee. Others found it was not to their liking, and many participants mentioned that they found it far too sour. A few participants had had accidents with the carbon dioxide building pressure inside the bottle that they neglected to release and had splattered kombucha all over their kitchen. Some stopped trying to make it at home after that experience. People also worried about the amount of sugar used for making kombucha ("It bothered me a bit, all that sugar that's put in it."). Even though they realized that it breaks down with the help of the bacteria and fungi, they still felt there might be something unhealthy about the volume used to facilitate the initial fermentation process.

Although most found the instructional videos prepared by our specialists on how to make various fermented foods inspiring, many of the participants nonetheless expressed unfamiliarity and insecurity regarding the fermentation processes. They asked questions on the Facebook group, such as "When are the vegetables ready?" or "Is it ok that there is a white thing on top of the kombucha?" or "Can you make

Figure 2. A screenshot from one of the instructional videos we made. Film (2022) by Hrafn Helgi Helgason. Presented by Dagný Kristinsdóttir.

fermented food from non-organic vegetables?" The participants seemed more at ease with making sourdough bread and fermented milk products than with kombucha or sauerkraut. This is consistent with current Icelandic food habits as revealed by a national survey conducted in 2019–2021 (Icelandic Directorate of Health, n.d.).

One of the challenges that people experienced was that they lacked a local community of fermentation practitioners. Some participants said that they would have made the food themselves if there were more people actively making it around them at the time of the study. Those who were used to making food from scratch found it easier to dig into the different recipes and test different things, even using non-Icelandic cookbooks and websites, trying out different types of vegetables, spices, and even fermented fruits. Those who had other interested peers around them also found it easier to prepare the food, as they could exchange experiences, share recipes from different countries, and laugh at their mistakes together. They also generally found that their own homemade fermented foods tended to taste better than the ones bought in the supermarket. Many of these participants mentioned how much cheaper it was to make the food themselves and had the added benefit of being able to choose from many different vegetables. However, more than one participant mentioned the need for a lot of space in the kitchen and even the need for an extra freezer to store materials related to the home-fermentation process. It was clearly easier for those who worked from home to both remember to eat fermented foods and to have time to prepare the food. As one of the participants described making kombucha:

> But it seems to me that I'm getting it, and I think it's also just if you let it wait a little longer it just gets stronger and the germs just work longer, so I think it's like you say you just need to put a little love and attention and stick with what you are doing. Then I like it. I also just like doing things like this myself.

However, in most cases, participants bought their fermented foods at grocery stores. Some tried to make fermented foods at home to begin with, but then stopped as they found it too time-consuming to prepare and monitor. When purchasing fermented foods, most participants were interested in tasting all the supermarket had to offer before selecting one or two regular products. In general, the participants requested a greater variety of fermented foods in Icelandic stores. For example, some participants mentioned that it was much easier to find sugary probiotic food items, such as the more common sweetened yogurt, than pure probiotic milk, which often can only be bought by the liter.

Not all types of fermented food were found in all grocery stores and even within the stores it was hard to find, as their staff did not know where to look. Participants living outside the capital area found it especially challenging to buy fresh sourdough bread, for example. A few mentioned that the best sourdough bread in Iceland could only be found in one bakery in Reykjavík. Several participants travelled abroad during the intervention period, and some of them reported that they found it hard to find the right products in the stores there. People would for example call our researchers to ask how to say "fermented" in Spanish.

The price of fermented food often came up in the interviews with those partici-

pants who purchased all their fermented foods. Bottles of quality kombucha at the supermarket can be quite expensive, especially when consumed every day or even twice a day. Even locally produced fermented vegetables are comparatively expensive when bought from the store.

The sour taste was a big challenge mentioned in many of the interviews. Sometimes, the participants found the yogurt or skyr from niche producers too sour for their taste buds and told us that they preferred the commercial ones which, however, contain far less lively cultures to extend their shelf life. Others embraced these niche products. Strategies to remove the sour taste of fermented vegetables involved mixing them with something fatty such as butter on bread, cream cheese, mayonnaise, or peanut butter, mixed with kimchi, cortido or sauerkraut, for example. Some participants added fresh vegetables or fruit to the fermented ones, and one participant in particular mentioned frying the fermented vegetables on a pan with sugar ("I fried onion, red onion, on a pan and added sugar, like healthy sugar, and added the fermented red cabbage. It was a big hit"). The participants tasted various products until they found ones that best suited their palates. In the end though, many people said that although they found the sour taste off-putting at first, they became more comfortable with time and even came to appreciate it.

Some participants did not eat bread, and others did not like kombucha. Consuming six portions per day was more challenging for those who did not have the full selection of food to choose from. It is also interesting that one of the reported challenges to fermented food consumption was their own opinion of people who are more dedicated fans of fermented food:

> Maybe I'm missing the extreme trait, excess. I don't have this excess. I imagine many people who go for this kind of thing go to extremes, try everything, and find it exciting and fun and everything. But I'm not there.

Participants were advised to change their current bread consumption and opt for sourdough bread only. Those who ate sourdough bread were happy with it, but it was clear that those who made the bread themselves had a closer relationship with their food and were glad to discuss different techniques for how to make different meals with sourdough, including waffles, Danish rye bread, pizza, and even muesli.

Whether substituting some of their regular food with fermented alternatives, or adding it to regular meals, all the participants tried with earnest to increase fermented foods in their regular diet, using fermented vegetables as a side dish with meat and fish or as a bread topping, and drinking kombucha instead of coffee or tea. Those exchanging some of the coffee for kombucha, as we recommended, reported feeling better as they had decreased their coffee consumption. Indeed, some of the participants were quite happy with the new foods and eating habits they had tried during the intervention:

> Yes, I often have kefir in the morning and naturally I use sauerkraut on everything now. At first, I thought it was bad and not very good, and I started there with the cab-

> bage that had caraway seeds in it. I thought it was really just disgusting to eat. Then I started to develop... or in other words… yes, just looking more and found something like this with a bit of a tropical feel and something from Korea and something, like… that had some strong spices added, and I just think it's really good... to eat this with everything. And I've just become hooked on kombucha. I think it's awesome and here… yes. So that's the main thing I eat. And naturally bread. If I have bread, it's sourdough bread.

Many participants also mentioned that it was harder to follow the dietary recommendations of the study during weekends, as weekday life is more consistent, with fixed posts throughout the day. Regular schedules made it easier to remember the fermented food portions.

One participant stopped eating fermented foods after the jar exploded or the vegetables threw themselves out of the jar due to gas build up when opened. However, another participant found this to be a very exciting experience and hoped for it to happen again:

> After that I always thought it should be like that, always got a little sad when it didn't happen. [laughs] Because it was something like that, it's so nice to eat something like that, that's just, yes, it just works like that, beautiful life. [...] Unbelievable, bubble bubble making quite a stir.

Despite stories like this one, few participants mentioned thinking about live bacteria in the food. However, some had more positive shifts about the presence of bacteria in their food:

> I don't think I'm impressed with fermented foods here at all, especially after this, especially not with vegetables, but on the other hand, I think my attitude must have changed in a positive way because you still realize that this must somehow be good. For the body. It's just that it's in the nature of things, I think, compared to these studies that you've only read about compared to what's behind the kefir and the like. Then I think my thinking is more positive than before. So, I imagine that as more is revealed about these things, the discussion will be more positive in society.

When asked about the reactions of family members, most participants reported that they were mainly positive, with partners or children starting in some instances to make and eat the same fermented food and finding it good. However, for some, enthusiasm seemed to dwindle towards the end of the intervention period, as by then they had mostly given up trying to follow the same diet as the study participants were following. Some of the participants experienced this dip in enthusiasm as well. At the start, participants were upbeat, but when they realized how much energy and organization was required in the food preparation process in additions to incorporating four to six portions of these foods into their diet per day, their enthusiasm deflated.

Some family members were sensitive to the smell of the fermented vegetables, and a few participants mentioned that they tried to camouflage the fermented food

by mixing it with other food for those family members who were more skeptical. In some cases, other members of the family did not participate at all, while conversely in some cases younger children were deeply involved and loved the fermented food and kombucha.

Friends and coworkers of those in the study tended to view the study positively. They were ready to taste some of the novel fermented foods, although not always ready to eat a whole portion except for the bread. Some found new allies at work:

> There is a Polish woman who works with me, and she was just so happy when I brought sauerkraut to eat. She just said that she never really sees Icelanders eating this and that it is eaten a lot in Poland. Not least with fish and such.

Other challenges were, for example, related to a bottle in the freezer at work that fell on its side and smelled, prompting comments from colleagues at work. It was a challenge to remember to take the sauerkraut to work and eat it. They pointed out that it would be easier if it was in the canteen (lunchroom) to begin with as a normal part of the meals provided by the workplace.

Some found the experiment inspiring and said they would continue to use and even make kefir, kombucha, and sourdough bread. Others stated that at the outset they had not been impressed by fermented food, and really disliked vegetables, but with time they had begun to enjoy them more. Some participants mentioned the empowerment they felt in baking bread for others, either at home or at work. Bringing fermented foods to the table became popular. In the end, some participants were determined to continue their own fermentation journeys. As one of the participants who gave herself time to make the food said:

> No, actually, I think it's just like I said at the beginning with regard to being able to participate in this, that it just opens up all kinds of opportunities. And this makes you think about this, that here it's not that complicated, if you just give yourself the time, you can do a lot of this yourself. And and and here I like listening to this interview with [sauerkraut expert], that's right, I saw it somewhere when she, or did I read it in the book, that she just found out about this and started bothering herself with this, fermented vegetables here, just keep an open mind about it and do it yourself and see where it takes you. That's how I feel that getting to take part in this study really opened my eyes to this diet and this world. So I only see an opportunity in this.

While many of the challenges the participants faced during the intervention study were specific to this context, the interviews provided many insights into the issues people confront when changing their diet. The interviews show a marked difference between those who had the opportunity and capacity to make food from scratch and those who relied on finding the fermented foods they liked in the supermarket, with the former group reporting a more positive experience of the intervention study overall. Challenges also included adapting to unfamiliar tastes and renegotiating what foods were liked or disliked. It was obvious that the sour taste that is characteristic of

many traditional fermented foods was not very palatable for many of the participants, although some of them got used to it over time.

Health Concerns

Many of the challenges participants faced during the intervention period were intimately connected with their own perception of how healthy they believed certain food practices, products, or ingredients were. As noted in e.g. Hey (2020) and Maroney (2020), the current interest in gut flora and effects of microbial life within our bodies on our health, risks reinforcing healthism (Crawford 1980, cited in Dryden 2023, 132), a managerial approach to human well-being where the individual is seen as both in control and ultimately responsible for their health through dietary and lifestyle choices. Recent developments include wearable technology and smartphone apps that give people the impression that they can manage nutrient and calorie intake in their diet. These perceptions were also mentioned in the interviews.

Among the health concerns cited by participants were factors related to the acidity and/or salinity of available fermented foods. One participant expressed worries regarding the effect of sour food on tooth enamel, and a recommendation not to brush the teeth straight after eating or drinking fermented food was put out on the Facebook site of the research. Some of the participants worried about the salt content of the food, both in the bread but also very clearly in the fermented vegetables. A 5% salt solution must be added to cut vegetables for preservation, because it supports the growth of beneficial bacteria while deterring potential pathogenic activity. Participants with high blood pressure, who had been advised to avoid salt, were particularly concerned about this. High blood pressure was not an exclusion criterion for the study. In two cases, participants reported that a common health monitoring app that they were using was warning them about the sodium content of commercially available sauerkraut. At the end of the intervention study, the blood pressure of one participant had increased so severely that he had to increase his medicinal dosage for the treatment of his hypertension.

In the interviews some participants expressed worries that eating bread would cause weight gain and that they were eating more bread than before. Others did not consume any bread during the study, as they did not regularly eat it, often citing challenges relating to their own body weight. This was especially evident among people who had experienced health problems, such as knee injuries or were pre-diabetes.

Overall, most participants mentioned that they were happy to participate in the project and try something new. A few, however, were disappointed that they did not feel better after a few weeks of trying this diet, as they hoped. Some even said that they got more heartburn and digestive problems, mainly increased gas, while others felt it had no effect.

On the other hand, many reported that they felt better than they did before the start of the study, saying that the fermented food was beneficial, and that they experienced better digestion, less distention, and less gas than before. This was even reported by those with a sensitive stomach:

> I felt a difference after about a week. About five days - a week, then I noticed a difference in... in this way, yes. Just feel better about it. I wasn't as bloated as I was saying earlier and stuff. Yes. That's the main thing.

Some participants also mentioned that they felt more satiated after eating fermented food, such as fermented vegetables. Some also noted that fermented foods affected their desire for other types of food such as cola drinks:

> Yes, but I am a Coke fan, or was a Coke fan. It's my greatest weakness in life. It's just Coca Cola. I just avoid imitations. I don't want this diet junk; I just want sugar in it. But now I don't want it, it's so remarkable. I have, you know… I drink at least 330 ml [about 11.16 oz] a day of this kombucha, sometimes more; and I don't reach for the Coke. I just realized it the other day. Because I, yes... because it's been such a joy for me, you see. I don't drink... or you know, I drink beer and red wine and stuff like that, you know, but I don't drink much, and I've never smoked and stuff like that. But... but here Coke has been my main thing and now somehow, I don't need it anymore. I just realized this now while we are talking. I just haven't had a Coke.

Some felt that there was a marked difference between eating unhealthy food and the fermented vegetables, and expressed a determination to continue incorporating them in their diet after the intervention period:

> Just somehow, just like when you eat unhealthy things if you get sugar, you feel it. You just get a little dull and foggy in your thinking. This is the exact opposite of that. You become clearer. So, this will definitely happen with the Christmas dinner, no matter what my husband says [laughs].

In general, many of the participants had already formed an opinion about the possible health benefits of a probiotic diet. Several talked about reading books that recommended fermented foods and "eating for your gut" (one mentioned for example Michael Mosley's *The Clever Gut Diet*). Citing research she had read, one participant specifically mentioned colon cancer and attention-deficit disorder (ADD) as examples of conditions that she believed might be caused or exacerbated by an unbalanced gut flora.

In several cases participants' ideas about the health benefits of a fermented diet were mediated or prompted by personal experience, such as having had to use medicine to aid digestion in the past. A personal experience of a diet change in the past correlated in some cases with a positive evaluation of fermented food in general, whereas a health condition such as high blood pressure or having symptoms of diabetes in the past caused participants to be more skeptical and wary of the new diet.

Childhood Memories and Previous Experiences

The links between memory, food, and the past experienced through the development of a taste for certain foods and aversion to others has been explored by scientists in

many disparate contexts, such as Italian or Caribbean diaspora communities (La Trecchia 2012; Sealey-Ruiz 2004), tourism (Sthapit 2019), consumer behavior (Vignolles et al. 2014), nursing (Hanssen et al. 2016) and even war (Katto 2020). What emerges from the literature is the prominent role of memory in creating a visceral or "gut reaction" to certain types of food (see e.g. Pétursson et al. 2022, 62–63; Bernstein et al. 2009, 137), as well as a culturally determined critical component whereby people engage with their own sense of belonging (and non-belonging—see Vanha-Similä et al. 2023), and identity (see Abarca et al. 2016) in what they classify as food and the positive or negative values they associate with those foods. Food memories were not a part of our loosely defined frame of questions for the interviews. Nevertheless, many of the participants in our study mentioned how some of the novel fermented foods they tried adopting as part of their regular diet during the study had brought back memories, both fond and foul, from their childhoods, or past experiences.

Several participants remembered tasting kombucha prior to the study. Some had tried brewing it themselves while others had tasted the kombucha that their parents made. Two participants remembered that they found it "disgusting" and one mentioned that the reason for this was that the idea of brewing a drink using a fungus was somehow repellent:

> So, I had just gotten this fungus somehow, when I was little. I found it disgusting. It was some Caucasian fungus. […] I remember that mom put some vanilla extract in it to make it better and I thought it was absolutely diiiisgusting and I hated the smell of vanilla for many years afterwards.

In this case, the participant did not like the kombucha available on the market, and avoided it, although it was among the fermented products that we recommended. It is quite possible that the aversion she felt for the "Caucasian fungus" as a child had translated into a dislike of kombucha as an adult, even though she never explicitly stated that they were the same thing.

Kombucha has been a health fad in Iceland under such "exotic" names as the "Manchurian fungus," "Caucasus fungus," or even "Cossack fungus," referring to the SCOBY (symbiotic culture of bacteria and yeast), which is not a fungus at all, but a biofilm, rich in microbes, that mostly consists of a cellulose polymer that forms on the surface of fermented tea. Judging from the interviews, it seems that kombucha has had at least two such periods in recent Icelandic history, before it became popularly known as kombucha; one in the early 1970s and another in the early 1990s. A few participants mentioned folk beliefs and ceremonies associated with brewing kombucha in the past, for example the "rule" that whenever the SCOBY became too big it should be split in two and one half given to a friend (this is how the practice spread), and if a new home could not be found it should be buried in the ground, like a dead pet.

One participant mentioned that she had tried making kombucha in the past and had felt more energy after drinking a cup every morning. Eventually she found it a bit awkward and ended the venture by throwing the "fungus" away because she believed it had gone bad. Another participant mentioned that as a child she had snuck a drink

Figure 3. Participants in one of our courses learning how to make sauerkraut. Photograph (2022) by Áki Guðni Karlsson.

from the kombucha that her mother was brewing, because she liked it so much:

> [S]he kept it exactly in a wardrobe [laughs a little], because it had the best conditions [...] and it finished quite fast, because without her knowing, I was always drinking it. So obviously there I was… I liked it obviously; and probably… I must have felt it had a good effect.

Beetroot and cucumber are types of pickled vegetables that are relatively commonly eaten in Iceland, cured with sugar and vinegar, and accompany both fish cakes and the traditional Sunday roast. There hasn't been a native sauerkraut tradition in Iceland, at least not until quite recently. Several participants mentioned previous experiences

with sauerkraut, however, and in all cases, it was associated with other countries. One woman mentioned that her father liked sauerkraut. She believed he had learned to appreciate it while studying to become a gymnastics teacher in Scandinavia. Another mentioned spending a summer in Austria in her youth and remembered that she liked the sauerkraut there. She added that she had tried several times to buy a packet of sauerkraut in Iceland and did not fancy the taste. One woman specifically stated that she saw her participation in this research as an opportunity to try to eat more sauerkraut, as her mother, who was German, had made it when she was little. As an adult, she tried to find a product that was like the one that her mother had made:

> She made sauerkraut when I was a child. There was a big barrel in the storeroom outside with a lid that would lift. We liked it so much that we snuck out to the storeroom to steal some sauerkraut. [...] you know, it was probably just good for me back then.

She also mentioned trying sauerkraut at a conference in Bratislava in Slovakia, but she didn't like the taste because it was different from the one that her mother made.

What emerged from the interviews is that both sauerkraut and kombucha are seen as rather exotic and unusual products in the Icelandic context, probably making them sensorily "suspect." The "funkiness" of kombucha and the "foreignness" of sauerkraut can be offset however, by memories, where participants have grown fond of these foods as children. However, often this came with the caveat that they had not continued to consume them as adults and had been unable to find products that replicated their childhood experience, even if they were convinced that these foods were healthy and had been "good for them." Participating in the food intervention group in our research was seen as an opportunity to rekindle a lost interest, and participants readily associated the fermented foods that we recommended with the foods that they remembered from their past, creating what Abarca et al. (2016, 7) terms a "visceral self-awareness" that speaks through our senses. A historically positive association seemed to imply a liking for both sauerkraut and kombucha, whereas a negative past association implied aversion, at least in one case.

Another type of fermented food that is also sensorily suspect, although intimately familiar to many Icelanders, are meat products stored in fermented whey. This was a traditional method of storing meat in Iceland, as a lack of firewood in a largely deforested country implied a general lack of salt. Whey was abundant, however, as a byproduct of making butter and skyr (a fermented dairy product, similar to yogurt). Once it was acidified, through the action of lactic acid bacteria, it would keep meats, sausages, and other animal products unspoiled for many months, while also altering their taste. With modern refrigeration, this food conservation method became a relic of the past. However, the taste of meat pickled in sour whey was familiar to most generations of Icelanders living in the 20th century, and many people still appreciate food cured this way, although it is much less common than several decades ago.

Traditionally cured meat was not one of the explicitly recommended fermented foods to our food intervention group. However, during the interviews, we prompted the participants to discuss their familiarity with this kind of food, if they didn't offer

that information spontaneously (many of them did). Several participants mentioned that they found the smell or texture disgusting, even if they were regularly presented with this food as children. Others stated that they enjoyed fermented meats because they grew up eating it, although one mentioned that as a teenager she found it embarrassing to know that her father kept a barrel of whey on the balcony ("I thought it was a bit uncool to have a barrel with sour and old-fashioned food."). She still liked the taste, however. One participant stated that as a child she considered sour whale blubber and ram's testicles special treats. Another participant associated this tradition with a lost skill in food preparation and connected with the ideas of "making food with love" that she remembered from both her grandmother and her mother-in-law, while she herself "wouldn't know how to make" this kind of food:

> Yes, you do that of course and also because grandma, my dad's mom, always did a lot of this, and she did a lot of this type of food and made the loin sausage [lundabaggi - traditional Icelandic sausage made using lamb loin] herself which was then placed in the fermented whey, and she made the head cheese [sviðasulta - from sheep heads] and was a big food lady, you know. So, yes, it really takes me back, you know.

One of the participants said that she had been brought up eating very old-fashioned foods, and never liked whey-cured meats, but she wondered whether she might appreciate it once again because of a belief that "our taste buds change with age." Another said that he believed that fermented foods had been a bigger part of his diet in the past and his participation was an opportunity to refresh his memory of its taste.

Some of the participants mentioned being brought up with "old-fashioned" foods: fish for lunch and meat for dinner, with skyr and buttermilk for dessert. Despite its iconic status as a staple fermented dairy product, skyr was rarely mentioned in the context of food memories. It is, of course, neither exotic nor old-fashioned, and perhaps too ordinary to deserve a special mention. Skyr, kefir, yogurt, and other fermented dairy products were included on the list of suggestions provided to the food intervention group participants. A participant noted she had decided to participate because she had felt that as a child this kind of food benefitted her health, and another discussed how his past habit of eating a lot of skyr had prepared him for the food he was eating in the intervention study. One woman specified that she saw her participation in the study as an opportunity to connect with the memory of her recently deceased mother who had been a regular sourdough baker.

The food memories expressed by our participants in the interviews involved many kinds of engagement with their experience of fermented foods. Several accounts constitute what Pétursson et al. (2022, 29) call "reflexive nostalgia," juxtaposing past and present experiences. In some cases, what we have are strategies of associating unknown foods with familiar foods that have similar sensory characteristics. This is used, for example, in food chaining (see e.g., Coulthard et al. 2022), a method for treating reluctance to try new foods in adults and children. The participants' positive or negative assessment of past food experiences was also informed by traditions (being brought up with this food) and personal life-stories (memories of a lost parent).

There was also a strong thread involving health concerns, based on the assumption that what we instinctively liked as children must somehow be good for our health. As noted above, health concerns and ideas about the health benefits of fermented foods were prominent in the interviews and were a motivating factor in volunteering for the research. Memories of past experiences with fermented foods had in some cases shaped people's perception of both what kinds of food they liked and what kinds they believed were "good for them." Food memories directly affected the food choices participants made throughout the study.

Conclusion

From the seventeen interviews conducted with participants in the fermented food intervention group of the study, participants encountered more challenges than they had originally thought they would when they signed up for the study. We specifically asked about this during the interviews, so people were encouraged to think about hurdles and issues when partaking in the research. These ranged from practical constraints resulting from lack of time, kitchen space or money, to people having issues with sour taste, or health concerns related to overconsumption of carbohydrates, sodium, caffeine, or alcohol. The six-portion mark set in the research design proved to be very challenging, especially for those who discovered that they did not like one or two of the fermented foods we recommended and were unable to find substitutes, and for people who were not in a set routine for the whole eight-week period. In fact, what emerged from the interviews was that most of the participants seemed able to consume four to five portions daily.

One lesson learned from the study is how important it is to be available and proactive while interacting with the study participants. Many of the concerns raised in the interviews about fermented food containing too much salt or bread giving a lot of energy and carbohydrates, were not raised on the Facebook page or when in direct contact with the researchers during the intervention period. In our view, the change was irrelevant, as participants were asked to substitute their habitual bread consumption with sourdough bread. The recommended daily portion of fermented vegetables would not have added more than 0.7 grams of salt to the daily diet. Yet it would have been better to address these concerns at the outset, for example through a pilot focus group, before starting the study.

An interview with a nutritionist was optional, but those who discussed their diet with a dietitian were more secure in their actions. It might have increased compliance and reduced confusion to push this option more.

It is also clear from the interviews that participants signed up for the study not only out of interest in fermented food and intestinal microflora, which was the main reason the researchers would have guessed. They also stated they wished to change their diet in some way. Some described positive changes when changing their diet in the past. Others mentioned participating because they had experienced ongoing digestive problems, and one participant even stated that he jumped on all opportunities to do something fun. Most participants also wanted to receive personal results from

the questionnaires and biosamples. Interest in fermented food was not, as such, the main driving force for volunteering to participate.

Using a mixed-method research design, we were able to gain rich insight into the challenges and strategies deployed by the participants from the interviews, which, combined with the data from the compliance surveys, demonstrate not only that most people found it difficult to comply with the six daily portions of fermented foods, but also provides important directions as to why participants found this consumption level difficult, and what they did to overcome those difficulties. While this article is based on a preliminary analysis of the interviews, we plan to further explore the potential for a combined analysis of the qualitative data with analysis of the biological samples collected during the intervention study.

This study demonstrates how the change from a diet low in fermented foods to a diet high in fermented food entails a rage of challenges, which have more to do with personal, physical, and practical constraints than with the regulatory and safety challenges that are often the focus of such studies (see e.g., Paxson 2021; Sanders 2018). It also highlights some of the viable strategies that people use to overcome such constraints, adopting novel food items as part of their daily diet, and referring to food memories when reaffirming their choices to themselves and others. The current study will increase our scientific understanding of challenges and strategies for adopting a fermented diet and might, with time, influence dietary recommendations and practices for improved well-being.

Notes

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Microbiosocial: What if the Holobiont was the Starting Point, not the Endpoint?

Salla Sariola
University of Helsinki
Finland

The introduction to the special issue "In Relation to Microbes" by Hafstein, Karlsson and Kinnunen ends with the statement: "unlike our universities, life itself is interdisciplinary" (**p. 10**). With this comment, the editors remind us that when studying social microbes and cultures of cultures (Brives et al. 2021), we should not limit our gaze by disciplinary silos and methodological boundaries because the "world out there" does not. Universities are organized around disciplines in teaching and recruitment, yet how the materiality of microbes and the social practices that shape and are shaped by them defy such traditions. The comment by the editors could well be interpreted as an invitation and mandate to collaborate across disciplines when studying microbes. For one, it would be impossible to know exactly what microbes are where without the methods of science, culturing, metagenomics, etc. However, instead of following this line of argument in this commentary, I will make a conceptual intervention following their statement about the nature of relations. What I take from their comment is that reality is *messy* and constantly changing through an *unruly process of multiple* agencies. Reality is *microbiosocial* and all creatures are more than one; *holobionts*.

Holobiont is a term that describes interdependence and the coming together of more than two species. These may depend on one another in more or less mutually beneficial relations (Chiu and Gilbert 2015). *Holos* in Greek means all, *biont* stands for the unit of life. By definition, holobiont is an intermingling of many, rather than the idea that there is something like an independent singular species that happens to be the companion of another. As such, the entity of analysis is the co-mingling, and neither is without the other. In social sciences, literature tells us humans with their gut microbes are holobionts (Benezra 2023; Lorimer 2019). To paraphrase fermentation analyst Maya Hey (personal communication 2024), let us call us *humans** from now on. Biologists remind us that such relationality is not just ammo for the deconstruction of anthropocentrism but that various other nonhuman animals and critters form holobiontic combinations (Theis et al. 2016). The idea of the holobiont begins to break down the idea of bounded species and introduce the need to pay attention to the relations and what happens "in between."

The articles in the special issue support the editors' comments in the introduction that life is interdisciplinary in multiple ways. If holobiont were the starting point, rather than the endpoint, what would it look like?

Ögmundardóttir and Bragason write beautifully about human-compost-soil-microbe-plant assemblages. Cassa's expansive analysis of the multiple kinds of microbes tinkered with permaculture gardeners brings attention to insect-food-garden-human-lactobacilli webs. Corporeal analysis by Kinnunen

Cultural Analysis 22.2 (2024): 136–151

powerfully paves the way to sensory ways of knowing microbes and the olfactory sense-bokashi-human-food waste-microbe relations. Sturludóttir and Pétursson tune into microbes in their analysis of car-sourdough starter- bread-baker-microbe-hand-kitchen-flour-water symbioses. Studying food preservation, Foltz elaborates on preserves resulting from orchard-plum-human-lactobacillus relations. Moreover, Birgisdóttir, Karlsson, and Pétursson describe a dietary intervention that concerns memory-ferment-taste-human interactions.

The long, awkward lists of actors bring our attention to the relations, the *dashes* in between. They also drive us up against the limitations of social scientific concepts. In the development of disciplines during the evolution of sciences at universities, task divisions have developed such that what people do has been reserved for social scientists. In contrast, matters of the body and the environment have been reserved for biomedical scientists and biologists. While this is a crude generalization, and the work of STS scholars and medical and environmental sociologists and anthropologists have brought the divide into question, it is nevertheless reflected in the terminology available to social scientists to talk about matters of microbiosocial. I argue that binaries of social vs. biological, nature vs.s culture, human vs. animal, etc., are redundant in the face of what microbes show us about the complex relations of embeddedness. To this effect, I invite the community of scholars interested in thinking with microbes to critically examine the limits of our concepts and tune into the needs of a microbiosocial world that is "interdisciplinary" and made of holobionts. When the world is microbiosocial and made of holobionts, to make sense of the complex relations of embeddedness without the dashes, what other terms do we need?

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Multiple, Messy, Microbial

Amber Benezra
Stevens Institute of Technology
USA

Humans are messy and multiple. And, so it seems, are our entanglements on this planet: with land, soil, and multifarious environments; with a dizzying array of other life forms; with time, histories, and sociality. One wonders, if microbes had a choice, would they even bother with us? We're so high maintenance.

For several years, social scientists, philosophers, and humanities scholars have been speculating about microbes and microbiomes, and what the existential implications are for humans. These questions have been broad and abstract, primarily circling the now overwrought "what makes us human (if we're microbial)?" question. But this collection of essays is doing a more interesting kind of work. These authors have been researching how microbes figure into human lives, practically, materially, fleshly—and in turn are studying what meaning is made through these practices. Veera Kinnunen is translating the olfactory language of microbes in bokashi to one that humans can understand and heed. Bryndís Eva Birgisdóttir, Áki Guðni Karlsson, and Jón Þór Pétursson matchmake between humans and microbes to see if humans can collaborate for their own health. Maria Giovanna Cassa is learning from microbes who tie humans to the past and nature through permaculture. Ragnheiður Maísól Sturludóttir and Jón Þór Pétursson are creating *with* microbes, necessary partnerships that yield sourdough bread and care. Lindsey Foltz follows microbes in post-socialist home food preservation practices as they change over time. Helga Ögmundardóttir and Eysteinn Ari Bragason investigate composting microbes that facilitate climate activism in human counterparts.

What is powerful and engaging about these articles is the astounding amount of meaning and hope that is produced. Academic analysis is so often a takedown, where critique is celebrated and mashing different jargony words together to invent new theoretical phrasings is the goal. I'll admit, I've done it myself! Grab the social, add a microbiome and a pinch of exposome, and voila! Out pops socio-exposomicrobiome (a word I have actually used, much to my chagrin). But the researchers here are concerned with something more; as the editors point out in the issue introduction, their attention is intentionally on "affirmative" relations with microbes. And honestly, academia could use a little more affirmation, acknowledging complexity and disorder while also tracing out the promise of things. There's no hard microbiology here; these scholars aren't doing bench or metagenomic science, nor working with those that do. But they are doing anthropology, folkloristics, ethnology, sociology, all while *accounting for microbes*, which "troubles the waters of inside–outside, biological–social, community–individual" (Benezra 2023, 7).

The issue editors, Valdimar Tryggvi Hafstein, Áki Guðni Karlsson, and Veera Kinnunen discuss the "fermenting" of human social and microbial cultures into an inextricable, generative concoction. Relatedly my book, *Gut Anthro,* is centrally

concerned with these interrelations, and uses "a framework of shifting microbial ontologies to tell the coevolving stories of the social and biological sciences and also to situate physical and conceptual spaces as coevolving sites" (Benezra 2023, 26). Fermenting in foodmaking is the transformation of one substance into another through bacterial action; social or political ferment is the incitement for change. Again the double meaning applies–as microbes ferment flour and water into sourdough bread, food scraps into nutrient rich soil, and cabbage into kimchi or sauerkraut, human composters, permaculturists, and bakers are also changed through their microbial relations. There is no separating the biological from the social, the environment from the individual, or the human from the microbe. These essays explore these "*pro*-biotic" relations ("In Relation to Microbes," this issue).

For me, clear temporality- and scale-crossing themes emerged in this collection. These authors, though dealing in different ethnographic subjects and research areas, hone in on corresponding, complementary ideas. *Care*: we care for microbes and they care for us. *Resistance*: microbial relations produce activism and advocacy. *Reimagining*: reimagining time, as microbial stories tie us to the past and future; and reimagining through microbes what is valued and what is "waste."

Care

Mutual care, caregiving, kinships developed through practices. We care for microbes and they care for us. **"**Compostories**"** tell us composting is deeply personal and requires trust that the microbes will eat and break down materials, people trust their smell and touch that the soil is transforming. Productive co-creations between earth, microbes, humans, and environment defy scale and individualism, "with the slowly flowing and circular temporality of composting comes the ever-increasing intimacy between the composter and their compost" (**p. 20**). Ögmundardóttir and Bragason teach us that compost spreads care through soil to people, companion actors work together, care for living things in different forms, other humans and beyond. People practice self-care, experience creativity and tactile pleasure in compost relations. **"**In the Company of Bread**"** humans and microbes communicate with each other; the sourdough mothers tell the bakers what they need and bakers take care with dedicated intentionality. Sturludóttir and Pétursson show how well-being circulates between microbes thriving in sourdough starter and people who eat delicious sourdough bread. Humans tend to themselves by slowing down and taking purposeful action by nurturing microbes in their starters. In **"**Smell as Transspecial Correspondence**"** microbes "talk" through smell, the bokashi communicates urgency, distress, and contentedness through the odors it emits. Kinnunen calls and microbes respond with stinkiness as "a reciprocal form of negotiations or conversations with the microbial communities living in the bokashi matter" (**p. 69**). Bokashi necessitates a weighty kind of care, taking smells seriously, taking microbes seriously.

Resistance

Microbial relations open a path for climate care, social, economic, and political activism. By **"**Setting the Table for Relatedness**"** through the practice of permacul-

ture in Sardinia, people, plants, soil, and microbes become more resilient through biodiversity. Permacultural practices value relations and eschew consumerism and environmental extraction, instead developing ethical ecological systems. Practitioners resist historical classism and seek food sovereignty, fermentation and the collusion of microbes at the center. As human and microbial solidarity is based on accountability and fairness, "food fermentation can thus be understood as politically situated in a discourse of resistance, a day-to-day revolution" (**p. 56**). In "Microbial Entanglements in the Bulgarian Cellar," "[b]eyond food security, these home-made and preserved foods promote food sovereignty and sit at a nexus of social practices preserving biocultural resources" (**p. 99**) Bulgarians manage post-socialist foodways that tie microbial action to past and present politics. Composters in **"**Compostories**"** resist landfills, reduce waste, and operationalize climate activism. "Composting in general, whether of garden or kitchen leftovers or, indeed, of humanure, goes against the grain of linear thinking and the commercial logic of contemporary Western society" (**p. 30**). Composters use microbes to advocate for healthy environments and climate action.

Reimagining

Telling microbial stories ties us to the past and future. Microbes cross temporalities, from the recent past to the ancient. Foodways, historical traditions, personal pasts, climate change. Permaculture in **"**Setting the Table for Relatedness**"** renews historical land use practices and wires humans into ethical interactions with soil, organisms, earth. Microbes in sourdough starters can be decades or centuries old, existing as a living archive **"**In the Company of Bread**."** Microbes aren't just crossing temporalities, they are shaping human experience of time, "for these bakers, the life of the sourdough is intimately connected to their own lives. The everyday rhythm of caring for their sourdough can be a trip down the baker's memory lane. The sourdough therefore creates several connections with the past: one's personal history and family history, but also microbial ancestry as companion species to humans" (**p. 88**–**89**). In **"**Fermented Living,**"** nostalgia and connection with childhood food experiences were tied to complex reactions of disgust or enjoyment for adults introducing microbially fermented foods into their diets. "Memories of past experiences with fermented foods had in some cases shaped people's perception of both what kinds of food they liked and what kinds they believed were 'good for them.' Food memories directly affected the food choices participants made throughout the study" (**p. 132**). Birgisdóttir, Karlsson, and Pétursson work with the challenges of trying to change peoples' nutritional present, while the actions of microbes in the past made an indelible mark. And lastly, many of the articles use microbes to rethink what is valued and what is "waste." Kinnunen disarticulates concepts of waste in **"**Smell as Transspecial Correspondence**"** recognizing waste as a communicative, unruly, lively entity, with environmental, relational value. "Dirty and stinky engagements with bokashi enable paying attention not only to the celebration of friendly conviviality but also to the constant and often untidy negotiations and exclusions that take place in real-life human-microbial relations" (**p. 71**). Kinnunen pushes us to interro-

gate the Western imaginary that excludes smells, microbes, and waste as "bad."

This special issue is so full, abundant with messily multiple relations, overflowing with ethnographic accounts of the sociocultural practices tying people to microbial kin. Elsewhere, I have used this formulation (Benezra 2021, 2023), calling microbes kin—certainly to the horrified dismay of anthropologists striving to keep human cultural lives centered in the discipline, and likely to the yawns of those already steeped in transspecies thinking and doing. But I stand by human–microbe kinships, and the essays here show innumerable ways these kinships emerge, take shape, and evolve. Kinship, like symbiosis, is not always utopic, as I found in my own ethnographic fieldwork. "To be clear, while many social scientists and philosophers are excited about these relationships because of the connection and companionable-ness they insinuate, microbial kin are not just happy-go-lucky messmates. Once a microbial ecologist told me, 'Commensal microbes are friends until they aren't. There's no such thing as a *good* or *bad* microbe.' The merit or menace of microbes is entirely dependent on where, when, and how they are situated" (Benezra 2021, 520). This collection studies this situatedness of microbes, and all of the essays follow a guiding tenet: that humans and microbes are always obligatorily related. Surprisingly, so are biological and social science disciplines. Hafstein, Karlsson and Kinnunen remind us "[e]mpirical research on microbial relations also makes it very clear that we are never alone, neither in life nor in science; we have no other choice, therefore, than to learn from other fields and seek fruitful dialogues across disciplinary divides" (**p. 10**). Social science already knows this, but these essays point us to the next step—now these cross-discipline, cross-species relations require us to develop ethical, relational accountability (Donald 2016; Reo 2019) with our microbial kin, and with each other.

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Fermenting Cultures

Bernhard Tschofen
University of Zurich
Switzerland

This special issue of *Cultural Analysis* deals with a topic closer to us than almost any other. Nevertheless, at the time this journal was founded, now a quarter of a century or even ten years ago, it would hardly have been expected in a journal dedicated to the study of culture. But this is precisely why "In Relation to Microbes" is a concern that is almost prototypical for the ways of thinking and working of an anthropologically informed cultural analysis, as it directs our attention to a world that surrounds us as a matter of course (actually: also fills us), but which remains strangely distant and invisible to us. On the one hand, this is a special attraction—a *terra incognita* quasi in our immediate vicinity—but also a special challenge. Dealing with microbial relations and the practices of their everyday negotiation, whether in the kitchen, garden, or cellar, or our thinking about health, sustainability, and the good life, also touches on our ideas of the boundaries of human, cultural, and scholarly competencies.

I, therefore, take the fittingly wonderfully ambiguous title "Fermenting Cultures" as an opportunity to comment on the thematic issue on three levels. To the two perhaps more obvious dimensions of fermenting cultures (in the sense of "natural" processes, 1) and cultures of fermentation (in the sense of "cultural" interactions 2), I would like to add a third aspect that is of particular concern to me: "Fermenting Cultures" should also be understood here as a dimension of the epistemological and methodological incubation of our engagement in the field of culture 3).

1. Fermenting Cultures: Shedding Light on the Overlooked Cultures

There is a lot to learn from the six articles in this issue. First, the breadth and relevance of the topic are addressed in this volume. It does not claim to be exhaustive or present only random excerpts. Rather, this issue succeeds in a good cultural-anthropological manner in not only illuminating exemplary fields with significance beyond the individual case in-depth but also in opening up connecting contexts with its general and conceptual discussions. I cannot go into the individual contributions. Still, I consider their compilation very successful because, with different cultures (in one sense), they also reach different places, social spheres, etc., and, thus, cultures (in the other sense). And this already captures a very important characteristic of microbiological cultures: They are omnipresent, but they only show themselves (at least to us and for analysis) situationally and in relationships. It is important and right that the contributors are interested in the knowledge of vernacular biology, and have an eye for the "how?": how it is talked and thought about, how bodies and senses are involved in these trans-species interrelations and make the other imaginable and negotiable.

It is also important to be reminded of where microbial relations are at work (in addition to the trends of fermenting food and drinks hyped in social media) and

how differently they work. The contributions are prime examples of ethnographic research that has grown in sensitivity and differentiation in recent years. We see this in the trans-disciplinary research of anthropology, science, and technology studies with biologists and nutritionists exploring topics such as Icelandic skyr dairy, composting in the garden, managing the bokashi bucket, networks of permaculture activists and sourdough bakers, or the indeed microbiologically infused Bulgarian oikos.

2. Fermenting Cultures: Understanding Cultures of Fermentation

This issue also demonstrates the progress of our disciplines—and transdisciplines—compared to the concepts and working methods of a few decades ago. The study of food and drink, its production and preservation, has had a long tradition in the anthropological disciplines, not least with a special shape in European ethnology and folklore. The techniques and ideas of agricultural production have also been widely dealt with. These subjects have always been interested in more-than-human life, at least indirectly. But when they dealt with the culture of animals or plants, even at the end of the 20th century—which, of course, was very innovative at the time—then it was mostly about ways in which (active) subjects and collectives dealt with a (passive) more or less natural counterpart. At best, this was understood as a construction of the shape of nature through culture and, thus, as a questioning of the clear boundaries of such orders of knowledge in modernity. However, the extent to which our thinking is captured in this has often been largely overlooked.

In this respect, the texts collected here penetrate new dimensions thanks to their cultural (and today, that means gender and knowledge theory) information. And, one might almost say paradoxically, they also come closer to the anthropological core concerns of understanding culture and society. What I particularly like about these contributions is that they do not blindly follow the microbiological trail but instead use it and the understanding of human-microbiotic collaboration to understand how this shapes social relationships and a general being-in-the-world. This perspective has dimensions regarding family, kinship, and society but also has an explicitly temporal dimension. Therefore, to understand the temporalities in these ways of thinking and acting, an expanded conception of historicity, which understands the mobilization of historical knowledge in the respective present as negotiated practices of shaping the future, is also helpful. This expansion becomes particularly clear in the contributions in which power relations are explicitly addressed and the political aspects of symbiotic care work are analyzed. In this respect, however, we should deepen our research on such topics; the interface with *Critical Heritage Studies* and an *Anthropology of the Future* seems to me to be particularly fruitful.

3. Fermenting Cultures: Microbiology as a Catalyst for Anthropological Thought and Work

The papers collected here each make an important contribution to a more diverse imaginable nature and, thus, at least indirectly, to an expansion of our cultural-analytical spectrum of cognition and its workings. In other words, "Fermenting

Cultures" are also something like incubators of our epistemologies and methodological dispositions. In my view, the contributions show one thing very well: the preoccupation with bacteria and fungi, with "cultures" (which, as a participial derivation of the verb *colere* in the Latin sense of the word, means something well-tended), is what makes the study of humanity complete. This approach does so paradoxically by simultaneously de-centering the human and completing it in its environmental and social relationships. Without cooperation with microbes, we cannot sour milk, regenerate the rare soil in our Nordic front yard, or politically remobilize old forms of solidarity in peripherized regions in the so-called Capitalocene. And perhaps, despite the proverbial "two cultures" (C. P. Snow), which repeatedly thwart the required interdisciplinary between the sciences and the humanities, they will also help us to rethink their boundaries and shared interests in the face of planetary crises.

However, getting out of our sometimes fairly harmless comfort zone seems important. Perhaps it is significant that, in turning to the elementary and vernacular, we move primarily in our milieus of an ecologically sensitive, educated world or, at least, seek its values in other fields. As fruitful as it may be to encounter rural farms, our kitchens and gardens (or Sardinian wastelands and Bulgarian storage cellars) with the conceptual apparatuses of science and technology studies, this attention to small-scale ways of dwelling and care practices could also distract us from the regimes and technologies that still determine our existence alongside such niches. It is, therefore, important that we open our gaze even wider in future research and take our critical ethnographic and cultural-analytical inspection to places where the industrialized and digitalized (AI-fueled) wind of "pasteurization" (B. Latour) continues to blow unchecked (albeit in an ambivalent guise!) and sometimes knowingly puts people and the environment under pressure. Dealing with antibiotic resistance and increasing allergies, the eco-digital regimes of the new precision farming are just as much a part of this subject area as dependencies and inequalities in the global beverage industry, to give just a few.

This extension is also about the benefits of a post-human perspective for anthropology as a human science, which should not be accused of anthropocentrism (and "culturalism") without a price. Despite all the criticism, it is, moreover, what characterizes our view of the social and wider world and constitutes our analytical capacity. I think that if we consistently develop the challenge of relational cultural analysis further by approaching other scales and politics of macrobiotic relationships with the same seriousness and attention to ruptures and contradictions, we can, once again, contribute to an (if one may say so) post-human humanization of human science. This engagement includes the small-scale and "subjectivization," but no less the interweaving of different scalings, in which microbes participate but are not the sole players.

Fermentation and More-than-Human Health: How to Speak of/to Soils and Other Aliens?

Daniel Münster
University of Oslo
Norway

There are many valuable insights to be gained from these accounts of human-microbial relationships in gardens of Finland, Sardinia, and Iceland. The people we encounter through these articles engage in complex relationships with microbial life in the form of Kombucha SCOBYs, compost heaps, bokashi and other strange liquids that accumulate at the bottom of bokashi buckets, Effective Microorganisms (trademarked as EM), kefirs, and JDAM indigenous microbial solution. These human-microbial performances (Ingram 2011) in the garden and beyond inspire me to reflect on three interconnected themes that I see as relevant in these emergent probiotic engagements with soils and the world of microbes: anthropomorphism, doing good with microbes, and health *as* ecology. Following Lorimer (2020) I call these human-microbial engagements probiotic, because they pose an alternative to the older framing of microbes as enemies and pathogens that need to be contained, eradicated, and controlled through regimes of hygiene and antimicrobial medicines.

Anthropomorphism

Microbial worlds are us, in us, and fundamentally alien to us. As Filippo Bertoni (2022) reminds us, since small beings had first become visible to the human eye with the invention of microscopes in the 17th century, their complexity, evolutionary importance to life on the planet (Margulis 1998) and their weird alien character have had the potential to "defract our view of the world in an always shifting kaleidoscopic multitude of alternatives" (Bertoni 2022). While the exact workings of microbial worlds remain a frontier of post-genomic sciences within ecology, medicine, and soil science for example, people who work with fermentation and composting are already engaging these alien intelligences. It may be fair to say that probiotic practices have successfully challenged anthropocentrism, the idea of a bounded pure human body so central to biomedicine, but have a harder time going beyond anthropomorphism, or thinking of other beings and entities as if they had human qualities. In pro-microbial communities across the world, and in the papers assembled here, anthropomorphism abounds. We learn of bokashi being "happy and contained," bacteria become "buddies," some microorganisms seem "nice and tolerant" and others "overbearing and demanding." Elaine Ingham, the inventor of compost tea ferments for gardeners, speaks of "mafias" and "bad guys" taking over the soil if toxins and synthetic fertilizers are applied to soil (preface to Lowenfels and Lewis 2006). Even posthumanists cannot help but to think of microbial communities and soils as caring, tolerating (our mistakes), communicating with us, and understanding us. My own entry into research on fermentation as world-making practice has been mediated by the Indian natural farming guru Subhash Palekar (Münster 2021). Palekar, who is at the forefront of teaching microbial consciousness and

symbiotic thinking to small-scale farmers and gardeners, relies heavily on anthropomorphic metaphors: mulching the soil is like putting on a sari (Indian female dress), nitrogen fixing bacteria are "contract workers" for God, and cow rumens are "factories" for producing beneficial bacteria. In this context it has been interesting to learn that Icelandic composters hardly relate to the world of microbes in their compost heaps, and instead cultivate affection for critters they can see. Soil meso-fauna seems to require less metaphorical work in representing nonhuman worlds. Composting moves their gardening practice beyond anthropocentrism, but can they also go beyond what might be called "eucaryotecentrism" (thinking with and relating primarily to multicellular organisms—eucaryotes—of plants, fungi, and animals). Microbes truly push the limits of multispecies methods. If anthropomorphism seems to me the last contradiction in breaking through to microbial worlds, the price we pay for communicating with and acting on microbial communities is a reminder of our human limitations in relating with other species and entities on their own terms.

Doing Good

Among the many images that will stay with me from reading the articles located in the garden is "knocking with your feet": the custom and idea in Sardinian hospitality that the ideal guest should have to use their foot to knock on the door of their host because they are carrying too many gifts of food and drink to be able to ring the doorbell or knock with their hands. Hosts, we learn, must reciprocate, and shower their guests with even more food and gifts upon departure. I was touched by this romantic image not only because I currently live in a country where guests can be expected to bring and consume their own drinks, but also because this image beautifully captures the idea of mutually beneficial generosity in fermentation and composting. Microbial communities can be tremendously generous guests, or hosts, depending on perspective. I have already mentioned their superpower in fixing (making available) nitrogen, an element that is crucial to all life but notoriously unavailable to plants because of its triple electron bonds. Bacteria in the root zone of plants (the rhizosphere) can break open nitrogen, fix it into a salt, and thus provide it to plants. Plants, in return, release sugar compounds into the soil, sharing the gift of their own superpower (photosynthesis) to attract and nurture microbes. The soil care communities we learn about in this special issue tap into and act upon the generosity and mutuality of microbes to build a better world above ground. I learned from these articles that people who work with microbes often marvel at their generosity and abundance. In composting and bokashi fermentation, microbes transform waste into beneficial materials that enhance soil fertility, break down unwanted waste, and contribute to the health and well-being of a wider multispecies collective. Two of the articles describe this work as ontological politics or as nurturing alternative ontologies. All three articles follow feminist philosopher of science Maria Puig de la Bellacasa's work on soil as bioinfrastructure and matter of care (2014, 2017). Fermentation and other soil care practices become thus part of a hopeful politics of enacting sociality based on care, collaboration and "being the revolution" (Gibson-Graham

2014). While I agree that fermentation and composting have strong ontological effects of placing people within a web of mutually nourishing life, my work on Indian natural farmers has also taught me a good deal of skepticism about the inherent goodness of soil care ontologies in a world where soil is part of unequally distributed land ownership, ideologies of nativist belonging, and has to stand up against loud voices of alarm that see productivist agriculture as the only viable option for feeding the world. As Anna Krzywoszynska (2020) reminds us, in capitalism, soil microbes are put to work according to the same extractivist logic that earlier made microbial life invisible to agriculture.

Health as Ecology

The articles on Sardinian permaculturalists, Finnish bokashi connoisseurs, and Icelandic compost enthusiasts show how microbial engagements spill from the garden to the kitchen and span at least three domains of health and ecology: waste, food, and soil. Composting and Bokashi transform kitchen and garden waste into a valuable matter, dry toilets do the same for human excrement and all contribute to closing circuits of energy and nutrition and break the cycle of capitalist waste production. Fermenting sauerkrauts, kimchis, kefirs, and kombuchas produce foods and drinks that nurture microbial diversity in human guts. Composts and ferments also contribute to the work of ecological repair either through bioremediation or by nurturing and enriching soils degraded by extractive practices and chemical inputs. Fermentation teaches us to pay attention to the blurred boundaries between waste management, food production, and health. Fermentation and composting are enactments of new facts of life that make the idea of individual organisms and bounded individuals that live *in* an environment untenable. Relations precede the contingent and dynamic formation of symbiotic assemblages called bodies or soils. Symbiosis, of course is not just mutuality, but also encompasses predation and commensality (eating along without harm or benefit). Donna Haraway, building on Lynn Margulis, speaks of holobionts "polytemporal and polyspatial knottings" that engage other holobionts in "complex patternings" (2017, M26). I am interested in what these new understandings and the associated practices documented in these articles can do to revisioning health and wellbeing. Fermentation and microbial thinking open a door to thinking health *as* ecology and not just as (human) health *and* ecology. Thinking health and holobionts together marks a fascinating shift in perspective where speaking of health or wellbeing depends on arbitrary cuts in deciding whose functional integration matters and whose doesn't. If bodies are rethought as "nested ecosystems" (McFall-Ngai 2017, M65), then health also must be reenvisioned without reference to bodies and organs. In assessing the health of complex systems, like soil (Harris, Evans and Mooney 2022), where do we seek balance, diversity, connectivity, and emergence? Which heterogenous assemblages should be restored to a healthy state? If we think of health as more-than-human health, we need to answer questions about value and valuation. Take the case of soil health. Soil is the ultimate challenge of thinking health without a body. It is impossible to establish a clear understanding of healthy soil without

thinking about valuations such as productivity or fertility. Soil is poor or rich, healthy, or toxic only in relation to other species' needs. For garden vegetables, nitrogen rich soil, rich in organic matter, are considered healthy; wildflowers, by contrast, regard sandy, nutrient poor soils as healthy. If we could ask them, would microbes even care about their symbiotic functions in an ecosystem? This brings me back to the alienness of microbial worlds. Bacteria and archaea are deep-time life forms, that developed long before plants, fungi, and animals. And they will certainly outlive us.

The articles I had the privilege commenting on bear witness to the remarkable renaissance of pro-microbial relationships in European societies and scholarship in the past few years. Already the introduction to this special issue shows how advanced the social study of fermentation, microbes, and pro-biotic practice has become. The social study of microbes can now build on an impressive literature at the intersection of science and technology studies, feminist philosophy, anthropology, geography, and varieties of multispecies studies. The empirical case studies located in the garden invite us to let the microbial turn challenge our capacity to represent microbial multitudes (and to communicate with them); to nurture our ambitions as "radical gardeners" (McKay 2011) to transform above-ground society; and to allow our fascination with microbial becomings to challenge the idea of health as distinct from ecology. There would be so much more to unpack in these rich studies, they really come knocking with their feet.

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