

# Teaching Embodied Fermentation Knowledges: Against Purity/ Towards Entanglement

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## **Abstract**

This paper looks at both theoretical and practical research on embodied knowledges and fermented foods. The paper consists of two chapters. In the first chapter, I discuss the history of human-microbial socioecological relations from 7000 BCE to the present. My second chapter describes my experience of teaching two fermentation workshops. I include a discussion of the participants' description of their experiences with integrating embodied knowledges, as well as a consideration of how their perceptions of bacteria changed over the course of the workshop. I also look at the class and gendered politics of fermentation workshops in this chapter. In both chapters, I follow Alexis Shotwell's argument against purity politics which "shuts down precisely the field of possibility that might allow us to take better collective action against the destruction of the world in all its strange, delightful, impure frolic" (9). I argue instead for complicated companion species relationships in order reimagine bacteria as pleasurable kin rather than microbial antagonists.

## **Foreword**

My Major Paper directly addresses my Area of Concentration “Popular Education: Food, Cultures, and Justice,” along with two of my components: “Bacterial Cultures: From Antimicrobial Fear to Fermentation Pleasure” and “Popular Education.” A third component, “Food Sovereignty and Food Policy,” provided ample material for a discussion on policy; although I had originally planned to include a section on policy in the major paper, it turned out to be beyond the scope of the specific research questions I wanted to address in the paper.

My first chapter delves into a discussion on how Pasteur’s scientific revolution spurred anti-microbial thinking, as well as how we have recently begun to think differently about microbes. It traces the discursive transition from “antimicrobial fear” to “fermentation pleasure.” I enact and discuss popular education in the second chapter, where I both reflect on the pedagogical experience of teaching, as well as on the workshop discussion I facilitated immediately following these workshops.

Note: all photographs and art included in this paper are my work unless stated otherwise.

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## Introduction

My connection to fermentation started in my mother's kitchen. My parents have made yoghurt since I was a small child. They bought a "Yogotherm" brand yoghurt maker at a yard sale in 1993. I wasn't involved in the yoghurt making when I was a kid, but I observed it as an everyday process; it was part of the weekly rhythm of our life. When I was a teenager, my mom explained to me how to make yoghurt. The process involves heating up milk in a microwave or a double boiler. You want the milk to come to a boil to denature the proteins in the milk and then you cool it down again to a warm-hot temperature, similar to bath water, or the temperature bread making yeast (*Saccharomyces cerevisiae*) like. My mom calls it finger-hot. This means it is cool enough that you can hold your fingers under the water (or in the milk) for a few seconds, but hot enough that you can only stand it for that long. I later learned during a fermentation residency that this temperature is around 115 to 118 degrees Fahrenheit. Using a process called backslopping, after the milk is finger-hot you add yoghurt from your last batch to the hot milk and keep its temperature for four to eight hours, transforming your milk into yoghurt. If the yoghurt making milk is hotter than this when you add the yoghurt, it will kill the yoghurt's *lactobacillus* bacteria and the yoghurt will not set.

For yoghurt temperature testing, there is a technological replacement for the human hand: you can use a thermometer. However, there is not a technological replacement for all things, and there is no substitute for embodied knowledge and careful observation. With many vegetable ferments, the embodied knowledge you need is of the texture, smell and appearance of the vegetables: you need to trust in your own sense of taste. Gaining this embodied sense of knowledge in vegetable fermentation is a process that takes time. My first experience with

vegetable fermentation happened when I was unwittingly thrown into fermentation at the farm I used to work at, Plan B Organic Farms, in the late summer of 2008. I was asked by one of the farm owners to make some fermented dilly beans. I was given instructions to layer the green beans with garlic and dill, and then told to put some brine on top (which was supplied to me). At the time, I didn't really know what I was doing, but I was intrigued and wanted to learn more.

At the farm, I found the book *Wild Fermentation* by Sandor Katz which I read and it got me more excited about fermentation. This inspired me to ferment in my own kitchen, and I got really into fermenting at home. From there I got the chance to do a fermentation residency with Katz in 2014 in Tennessee; the experience reinforced my belief that fermentation is something that anyone can do. A couple of months after getting back from the fermentation residency, I put work into improving my fermentation workshops, and facilitated two fermented workshops at Sketch in the summer of 2014. I wanted (and want) fermentation to be an accessible process, where you come home from the workshop and feel like it is something you could do, and hopefully will do again yourself.

Since taking Popular Education in the fall of 2015, I have started off my fermentation workshops by telling my fermentation story. I do this as a means of connecting with my participants and de-centring me as workshop facilitator from the role of "expert." One thing I learned from popular education is the validity of storytelling as a method. Storytelling helps to connect to participants' backgrounds and worldviews; they are not empty vessels to be filled with knowledge (the "banker model of education") but rather collaborators in the learning process. When I have told my fermentation story in workshops in the past, I have always

included either the green bean fermentation story or an anecdote about the fermentation residency I participated in. However, I have never started with the story of my mother teaching me about yoghurt making. I think this because yoghurt making was such a strong part of my rhythm of life growing up, I had neglected to think of it as part of my fermentation history.

“Fermentation is the transformation of foods by various bacteria, fungi, and the enzymes they produce” (Katz, 2012, 1). Although fermentation can happen without human intervention, it will usually proceed to rotting without that intervention. “People harness [the] transformative power [of fermentation] in order to produce alcohol, to preserve food, and to make it more digestible, less toxic and/ or more delicious” (Katz, 2012, 1). Pickling is sometimes equated with fermented foods, particularly sour lacto-fermented vegetables like kosher dill pickles or sauerkraut. But often when people talk about pickles or pickling they instead are referring to vinegar-based canning. Unlike fermentation, where the safety of the process relies on a diversity of microbes that change over time through a process of microbial succession, vinegar-based canning relies on high acid levels along with a complete absence of microbes to ensure food safety.

Fermentation interests me for a number of reasons. I love the seemingly magic process of food transformation that fermentation allows. I also love how good the products of fermentation taste. I like that fermentation is a hands-on way to combatting anti-microbial attitudes. I hope that eating fermented foods is contributing to my health, through the good bacteria and vitamins they contribute to my diet. Fermentation seems to be a breeding ground for community (both human and non-human). I have found this to be true both from the community I have found from participating in fermentation workshops and events, as well as

the community I hope I have a part in creating in fermentation workshops I facilitate. These communities include both people and bacteria, which I understand as within the realm of what Donna Haraway calls “companion species” (2008 and 2016).

The research questions I look at in this Major Paper are as follows. Can fermentation as a mode of creating companion species relationships move us away from what Alexis Shotwell calls an “ethics of purity” (2016)? More specifically, in chapter one I ask: What is the history of fermentation as it relates to human power relations and inequality? How did Western society develop an antibacterial attitude and what has changed to allow people to be more pro-bacteria/ post-Pasteurian? How is fermentation related to the development of human civilization? In the second chapter I ask: What can I learn about fermentation pedagogy from teaching fermentation workshops to diverse groups of participants? Can participating in fermentation workshops change participants ideas about bacteria and microbes? Can embodied knowledge be taught, and can it contribute to a process of making kin with microbes?

The first chapter is a history of fermentation and microbes, as they have been intertwined with humans throughout the past 9000 years. From the earliest histories of fermented fish, wine and sake, to the power of bread and salt; from sauerkraut’s entanglement in colonialism to the sexist history of fermented food industrialisation; from the Pasteurian origins of microbiology as distinctly anti-microbial to the most positive view of microbes to today, the history provides a necessary context for understanding contemporary fermentation relations. The second chapter focuses on fermentation in practice and explores the methodology, pedagogy, process, and results of two workshops I facilitated in October, 2017.

## Chapter 1:

### Historically Complicated Companion Species Relationships: Bacterial Buddies



We are all already polluted. We have more microorganisms in our guts than we have cells in our bodies- we are crawling with bacteria and we are full of chemicals. We are, in other words, continuous with everything here on earth. Including, and especially, each other. (Biss, 2014, 75-76)

### *Introduction*

Microbial and human histories have been intertwined in a complicated relationship for the past 9000 years. Through the creation of specific fermented food environments, we have shaped microbial domestication, and through this history of digestion, fermented foods have also shaped us. In this chapter, I will explore this relationship; in particular, I look at human histories of fermentation as companion species relationships that resist the qualities of a purity politics.

The definition of purity is “freedom from anything that debases, contaminates, pollutes” as well as “freedom from guilt or evil, innocence” (Dictionary.com). According to Alexis Shotwell, we are surrounded by movements toward purity, including everything from “detox” diets to “lifestyle” communities. “Purity politics arise not only in our response to potential physical contamination; it is also an issue for our ethical political situation in the world” (Shotwell, 2016, 6). While in some ways a politics of purity seems innocent, it is hyper individual as so much of it rests on not becoming contaminated, or polluted. However, as Biss explains in the quote above, “we are all already polluted.” One way to understand this is to see that:

there is no primordial state we might wish to go back to, no Eden we have desecrated, no pretoxic body we might uncover through enough chia seeds and komboucha. There is not a preracial state we could access, erasing histories of slavery, forced labor on railroads, colonialism, genocide and their concomitant responsibilities and requirements. There is no food we can eat, clothing we can buy, or energy we can use without deepening our ties to complex webs of suffering. (Shotwell, 2016, 4)

An example of the dangers of such purity politics is its ambition to achieve bodily purity. Bodily purity drove the eugenics movement as certain types of humans were seen as *more* pure and

thus more worthy of life, whereas the non-pure, “other” individuals (Jews, people with disabilities, queers) were murdered or sterilised (Shotwell, 2016, 12). In a world that desires purity, difference and complexity contaminate the individual. However, we are not discrete individuals and because of this, many of the pressing issues we face today cannot be dealt with on an individual level. Some of these issues include climate change, pollution, extinction, shortages of clean water, and growing disparities between rich and poor around the world (Shotwell, 2016, 111).

Shotwell argues against purity, because of all of the things purity as a politics of the individual cannot solve. Purity is

one bad but common approach to devastation in all its forms. It is a common approach for anyone who attempts to meet and control a complex situation that is fundamentally outside of our control. It is a bad approach because it shuts down precisely the field of possibility that might allow us to take better collective action against the destruction of the world in all its strange, delightful, impure frolic. Purism is a de-collectivizing, demobilizing, paradoxical politics of despair. This world deserves better (Shotwell, 2016, 8-9).

Sometimes when we think we are making the world better and engaging in collective action, we can still be engaging in a politics of purity. An example of this is the “vote with your fork” movement, in which purchasing more ethically produced or processed food is seen as a good way to contribute to food system change. These individual ethics are also an ethics of exclusion, where “we restrict ethical choice to the people who are most privileged by and within the system” (Shotwell, 2016, 125). These individual food ethics allow rich people to make the *purest* ethical choices when it comes to food. So although they might not always seem like a fight for purity but rather an attempt to make real change, individual actions like these easily fall into a politics of purity.

One way a politics of purity is enacted in capitalism is through scalability. Scalability in capitalism means that everything has to be scalable down to the level of the individual and up to the level of the plantation or the factory (Shotwell, 2016, 111). Scalability “is the ability for a project to change scale smoothly without any change in project frames” (Tsing, 2015, 38). Scalability also “banishes meaningful diversity, that is diversity that might change things” (Tsing, 2015, 40). This scalability is very clear in the history of the domestication of bread yeast. Prior to the domestication of sourdough cultures, wild yeasts (often *Saccharomyces exigus*), and varieties of *lacto bacillus* acted in tango with each other; their cultures were non-scalable because intimately connected to the specificities of the conditions in which they were produced. Later, in the 1800s, sourdough was transformed, as its *Saccharomyces* became domesticated and disentangled from its *lacto bacillus* co-conspirator (Gadsby and Weeks, 2003): it could go from place to place, small to large, reliably and replicably. The bread yeast used in industrial bread making is grown on molasses in factories in a process called the “Vienna process” (predictably developed in Vienna) (Harsford, 1875, 35). Part of why industrial yeasted bread became widespread by the early 1900s was the bread made in small urban bakeries was viewed as “a harbinger of death and disease” (Bobrow-Strain, 2012, 19), whereas industrial bread factory bread was viewed as pure as it was “untouched by human hands” (Bobrow-Strain, 2012, 20). This domesticated and decoupled *Saccharomyces* was developed into bread yeast or *Saccharomyces cerevisiae*, which is the yeast that makes the commercial bread that is stocked in today’s supermarkets (Bobrow-Strain, 2012, 192-193, Gadsby and Weeks, 2003). Today sourdough is making a resurgence, it is a product that is not scalable in

the way that yeasted bread is, because the long time it takes to rise and the need to keep a portion of the last sourdough batch to be used in perpetuity as a starter culture.



My sourdough culture.

One way a politics of purity is enacted is through individual food choices. Clean eating is a food trend that is currently very popular and closely follows this politics of purity. Clean eating is described as

a dysfunctional response to a still more dysfunctional food supply: a dream of purity in a toxic world...[it] is about ingesting nothing but 'whole' or 'unprocessed' foods (whatever is meant by these deeply ambiguous terms) .... At first, clean eating sounded modest and even homespun: rather than counting calories, you would eat as many nutritious home-cooked substances as possible.... But... "clean eating" [is] more than a diet; it [is] a

belief system, which propagate[s] the idea that the way most people eat is not simply fattening, but impure. (Wilson 2017)

Clean eating is very much about engaging in a politics of purity through an individual's food choices. Many clean eating blogs recommend eating fermented foods as part of this clean eating regime. In some ways, the eating of fermented foods makes sense within this logic, as these foods are considered "whole" and *only* processed in a traditional mode of processing. However, it is recent changes in discourse that have allowed us to understand fermented foods as *pure*. While sauerkraut today is often heralded as a miracle food and featured on clean eating blogs, it was only a couple of generations ago, that the 1963 *Joy of Cooking* (Rombauer and Becker, 1963) advised canning and cooking sauerkraut to ensure both its longevity and safety. We have moved from a notion of purity that held sterility as safety, to one that incorporates an acknowledgement of the diversity of microbial ecosystems that make up both our bodies and our (fermented) foods. They are both, though, politics of purity.

Part of how fermented foods have been enveloped into this new notion of purity, is through the idea that by eating these foods we have the possibility of returning to the purer human microbiome of our ancestors. The idea that the ancestral human microbiome is *more* pure than the microbiome that humans in Western civilizations have, comes from research on modern day hunter-gatherer peoples, like the Hazda in Eastern Tanzania and the Yanonami from the Amazon (Maroney, 2017). We assume that diversity of the ancestral human microbiome mirrors that of these modern hunter-gatherer peoples, but do not know how closely the human microbiomes of the Hazda or Yanonami resemble our ancestors', if at all.

Some of the health problems associated with the Modern Western lifestyle are beginning to be connected to our microbes. We want to have a purer (better) microbiome to

try to achieve this. The assumed purity of hunter-gatherer microbiomes lies in the fact that they are isolated from Modern Western civilization. The thinking goes that, perhaps we can achieve purity through eating fermented foods, and that perhaps these fermented foods will add the missing microbes that are lacking in our modern lifestyles; that perhaps we can return to a state of microbial purity. However, this idea rests on fermented foods being, in and of themselves, *pure*. This notion is false.

Fermented foods are not pure, in the sense of being uncontaminated by, or immune to, intervention. In fact, they are intimately intertwined with us, part of our histories and communities. This is most clear when we *eat* fermented foods. When Donna Haraway discusses eating, she makes it clear that it is never something that can exist outside of relationality. “In eating we are the most inside the differential relationalities that make us who we are... There is no way to eat and not kill, no way to eat and not become with mortal beings to whom we are accountable, no way to pretend innocence and transcendence or a final peace” (Haraway, 2008, 295). As eating always does involve killing, how can we make decisions about who is killable? What and who are considered “bare life”? (Agamben, 2004). And further, how do bacteria fall into these questions? “Why should we accord the cow more moral standing than the worm? And reprising Hird’s provocation about the potential ethical standing of bacteria, how can we act appropriately in relation to the bacteria that constitute the conditions of our lives? Here the inclination toward purity enacted through diet breaks against the intractable reality that death and life are entangled, just as our lives are dependent on others” (Shotwell 2016, 120). If we understand Haraway’s assertion that eating *always* involves killing, then Deborah Bird Rose’s ethical relationality can help us figure out where to go from here. Rose

suggests that it is impossible to have rules about who is killable. “If we hold fast to relational principles, then we face a conception based not on rules but action. Relationally, purity is a delusional *as-if*.... In contrast, the connectivities of life on earth ensure that we are always called to face ambiguity and to act and to be responsible” (Rose, 2011, as cited in Shotwell 2016, 125).

Fermentation is an ideal starting point to examine multiple relationships not just between humans and foods, but humans, foods and the microbes that transform our foods. Our human history is intertwined with this complicated relationship between us and fermented foods. These fermented foods have sustained us as we have inhabited the planet. Just as we have domesticated plants and animals, we have also domesticated the microbes involved in fermentation. This chapter explores these historically complicated companion species relationships and how the “human has been formed and transformed amid encounters with multiple species of plants, animals, fungi and microbes” (Kirksey et al, 2). From sauerkraut’s history of colonialism, power struggles over bread, the transformation of fermented foods being made by women to industrial production, (our relationships with) fermented foods have never been pure. In the rest of this chapter I will discuss sauerkraut’s “fucked up” ancestry, and food storage as transformative both to the domestication of microbes as well as to human settlements. I will also look at beer, bread and salt as intimately entwined in human settlements, and how the industrialization of fermentation has transformed gender and power relations. Finally, I will look at how Pasteur’s revolution changed the world, along with the post-Pasteurian resurgence of today.

### **“Fucked-up” Ancestries**

In “Companions in Conversation” Donna Haraway and Cary Wolfe discuss complicated, “fucked-up” ancestries, including histories of genocide, conquest, and colonialism (2016a, 222-223).

Cary Wolfe discusses bioartist Educarado Kac who “injects an animal identification microchip under his skin, but as the piece gradually takes different shapes, what you found out is that he has Jewish relatives who were killed in the camps” (Haraway, 2016a, 222). Initially it appears Wolfe is making a statement about how we are all seen as numbers: whether it is our driver’s license, health card, SIN card. Connecting this banal accessory to the Holocaust shows dramatically how even “product codes” have sinister histories.

While genocidal history is certainly an obvious example of these complicated, fucked-up ancestries, most of our histories are likewise complicated. Even Haraway’s beloved canine companion has a complicated history, intertwined with her human companion’s history. While Haraway’s dog is her companion animal, she moves away from the term companion animal to instead use the term companion species. “‘Companion Species’ is a bigger and more heterogeneous category than ‘companion animal’ and not just because one must include such organic beings as rice, bees, tulips and intestinal flora, all of whom make life for humans what it is and vice versa” (Haraway, 2016a, 106). Haraway’s dog is “a U.S herding dog, since her ancestors are the dogs who worked to develop the agribusiness ranching practices of the US west after the Gold Rush, she and I are children of conquest. From the beginning” (Haraway, 2016a, 223).

Bacteria are some of these more-than-humans that have been entangled and complicit in these complicated histories. Their use in fermented foods has increased the nutrition, as well

as the storage life, of many foods, allowing humans to survive times of hardship. These fermented foods also have a number of complicated histories that tie up bacteria up in their relationships with humans. Once exploration of the so called new world and the (ongoing) colonial project had started in earnest in the sixteenth century, colonial countries sent out men on long sea voyages to discover, explore, colonize, conquer, and settle these “new” lands. On these long sea voyages, people often got sick and died. One of the chief reasons for this was malnutrition, particularly vitamin deficiencies:

Perhaps one of the most bewildering aspects of the history of scurvy is the manner in which a cure was repeatedly found, only to be lost again because of a wrong theory of its manner of operation, or because some other factor offered a preferable explanation when it came to accounting for deaths. (Shephard, 2000, 204, drawing on Keevriil 1957)

It took a while, to figure out which foods helped to cure and prevent scurvy. At first, many ship captains and scientists believed that meat broth might be the solution to scurvy’s misery. Long before there was an understanding of *what* vitamin C was, some ship captains figured out that the key to preventing and treating scurvy was the consumption of certain fruits and vegetables, particularly fermented vegetables. It took even longer to discover what vitamin C was, and what vitamins as a concept were. Vitamins were described in 1912, by Gowland Hopkins, and vitamin C was first described and named as the element that prevents scurvy in 1917 by C. Drummond (Coulter and Lloyd, 1963, 123).

Long before this knowledge, however, Captain James Cook brought stores of sauerkraut on his ships on all three of his major voyages. Because sauerkraut is full of vitamin C (which the fermentation process preserves), he had a relatively healthy crew with few deaths. In its relationship with humans, cabbage in its fermented sauerkraut form helped to enable the success of colonialism (Shephard 2000, 203): a fucked up ancestry indeed. How would history

have been different without that sauerkraut on James Cook's voyages? To what extent would we as Westerners have continued to come across the ocean to colonize? Further, if sauerkraut had not been brought on James Cook's voyages (as well as other captains in the know), would the numbers and cultures of Indigenous peoples today be far stronger across Turtle Island?

When Haraway discusses humans and the nature of our existence, she emphasizes how we always exist in relationship. "There is no becoming, there is only becoming with" (Haraway, 2016a, 221). These relationships and symbioses that we build with companion species have a way of changing us. "Propelled by the tasty but risky obligation of curiosity among companion species, once we know, we cannot not know" and "Once 'we' have met, we can never be the same' again" (Haraway, 2003, 287). This is true, even when we are not always aware of the many relationships our bodies hold. So, while we might not think of eating as a process, a relationship, of "becoming with", it is. We are "becoming with" the microbes, the bacteria, the vitamins, and the enzymes in our food.

From my research, it seems that this process of "becoming-with" involves even more intertwining, more symbiogenesis or something like it, when we eat and make fermented foods and other foods with high levels of beneficial bacteria in them. There is evidence of horizontal gene transfer with seaweed and Japanese people's gut bacteria. Horizontal gene transfer (or HGT) is "defined as the non genealogical transmission of genetic material from one organism to another" (Gibbons and Rinker, 2016, 4) (See Appendix V). This non genealogical transmission means that bacterial genes can be transferred to other bacteria, without the bacteria engaging in bacteria sex, this can either happen through a bacterium picking up free floating DNA that other bacteria have shed, or through viruses that transport genetic material (Alexanian, 2017).

The evidence of horizontal gene transfer shows that genes that are otherwise only found on red marine algae, have also been found in the guts of people in the Japanese population. These genes help the red marine seaweed to be better digested (Hehemann et. al, 908). What this evidence of horizontal gene transfer points to, is the possibility for this “becoming-with” to be elevated (Hehemann et al 2010). The bacteria in our guts that carve out niche eco-systems in our mouth while we sleep, and that thrive on the very different micro-climates of our skin, have been “becoming-with” us since the day we were born (before that, we live in the womb, a sterile environment). Although there is not specific evidence that shows that horizontal gene transfer can happen with fermented foods we eat and our gut, people do posit it, and there is evidence that a shift in diet to either vegan *or* entirely carnivorous does rapidly change the microbial community of the gut (David et. al, 2014, 561). The hypothesis is that, historically, our diet varied immensely with the season and our gut bacteria had to keep up with these changes (David et. al, 2014, 561). “During the animal-based diet, three of the bacteria associated with cheese and cured meats (*L. lactis*, *P. acidilactici*, and *Staphylococcus*) became significantly more prevalent in fecal samples” (David et. al, 2014, 561). There is then evidence that the make-up of our diet, as well as the microbes from fermented foods do affect our gut microbiota; to what extent they have a long-term impact, and to what extent the microbial community in our guts seems to shift over time seems to vary.

However, with the bacteria that do the process of horizontal gene transfer in our guts, we have moved beyond “becoming-with.” When we transfer bacterial genes back and forth between us, (and these bacteria influence and change our digestive abilities) we become more than intimately involved with bacteria: we become members of bacterial community. This

harkens back to Donna Haraway's *Cyborg Manifesto*, where she describes how we are becoming more intimately connected to and fused together with machines: as "the difference between natural and artificial, mind and body, self-developing and externally designed, and many other distinctions that used to apply to organisms and machines" (Haraway, 2016a, 11). As Haraway later elaborates on in "The Companion Species Manifesto," we are becoming entangled with bacteria.

I think the concept of "fucked-up," complicated ancestries is important for understanding fermented foods such as kimchi and sauerkraut as it incorporates the knowledge of our domestication of microbes through processes such as backslopping (where you make the next batch of the ferment with culture from the previous batch). This domestication of microbes happened alongside the more commonly discussed domestication of plants and animals in the Neolithic Agricultural Revolution (Gibbons and Rinker, 141). Historically, how this process worked was through traditional fermentation:

food production practices such as back-slopping (the serial reinoculation of new foods with materials from previous products) resulted in the continuous and long-term passage of isolated populations of microbes under specialized environmental conditions, leading to adaptation and genetic differentiation. The domestication of bacteria, yeasts and molds was likely the unwitting result of Neolithic humans harnessing the metabolic capabilities of microbes in an effort to control the digestibility, palatability and longevity of their newly abundant foods. (Gibbons and Rinker, 2015, 142)

The domestication of microbes played a significant role both in humans settling down in agriculture and in Western colonization of the world. By continually making fermented foods, the microbes adapted to the fermented food environment, and become more efficient and in some cases more safe. In the case of the domestication of koji culture (*Aspergillus oryzae*),

widely used in miso, soy sauce, and sake -- over time and through the availability of steamed rice, it lost its toxicity (Gibbons and Rinker, 2015, 3).

So much of what we think of as human culture and the foods that we love so much are cultured foods: chocolate, cheese, wine, beer, kimchi, sauerkraut. What is culture without these cultures? This concept of human and fermented cultures being intertwined opens up a path through human history where power and oppression of humans by humans has travelled the same paths and been shaped by the food, fermentation and preservation processes that we have developed along with our microbe interlopers.

### **Food Storage**

These intertwined companion species relations do not come about in isolation, but are part of the context of the material worlds that enable them. One example of this entanglement is the development of food storage technology, which enabled new fermentation relationships to develop. In fact, intertwined histories of humans and fermentation likely started before humans were humans, i.e., *Homo sapiens*. There are many examples of animals eating fruit that has spontaneously fermented into alcohol, including primates, birds and fruit flies (Dudley, 2002, 283). This is a process that happens without any animal intervention as when fruit ferments it gradually transforms into alcohol (and then vinegar). However, fermentation is not just about the end product. In terms of the history of fermentation, what interests me more is when humans started *actively* fermenting foods, and developing these relations of care with fermented foods.

To be able to settle down, even for shorter periods of time, people needed a way to store food. Often what this storage is used for is fermenting. While today in Korea, for example, kimchi is fermented in stainless steel containers or huge ceramic crocks, historically it was fermented in pits in the ground layered with leaves. The earliest fermented food was fermented fish, which was fermented in a covered pit dug in the ground layered with leaves (Boethius 2016). Wine in France and an early form of sake in China came at a similar time period and were fermented in ceramic containers (Germano, 2017 and Graber 2016). The kinds of foods that are stored for long periods of time include dry goods like grains, as well as fermenting (and fermented) foods and drinks. The alternating seasons of abundance and scarcity that come with farming in a temperate climate and a settled lifestyle means that foods need to be stored and preserved. Some foods, like grains, are best kept dry. Others are fermented with salt to allow lactic acid producing bacteria to take over and transform the flavour and acidity of the food. The flavour change is a side-effect of the metabolic processes of microbes in the fermentation process in foods.

Beer and bread have been hugely important food sources since humans developed agriculture. It's hard to imagine a time before bread and beer because this was also a time before civilization and the development of written language. Nevertheless, bread and beer go hand in hand with the development of food storage in the transformation from hunter-gatherer worlds to settled agricultural societies where everything was communal and shared to socially-stratified unequal societies where private property develops and certain people had more power than others. Such unequal access to a basic resource such as food had impacts on social relationships and social structures, too. One theorist suggests "that the communal storage of

agricultural surplus might supply the leader with an opportunity to establish greater control over his followers” (Shordage, 2009, 42). Non-spontaneous fermentation is intrinsically linked to the development of agriculture and of complicated companion species relationships.

### *Bread and beer*

When we talk about humans as companion species with a diversity of creatures, the roots of the word “companion” come from Latin *cum panis*, meaning “with bread”; companionship is literally our bread and vice versa (Haraway, 2008, 17). For Aaron Bobrow-Strain, “a companion isn’t just someone you share bread with; it’s someone you are willing and permitted to share bread with” (Bobrow-Strain, 2012 6). So much of this rests on the balance of power not only between people but also between humans and more-than-humans. Politically, “ruling has always meant a tense dance between the power of the bread keepers and the demands of bread eaters” (Bobrow-Strain, 2012, 5). For decades, researchers have debated whether bread or beer was what enabled humans to settle down. What interests me more is how bread and beer, like salt, have been ingrained in the social and political fabrics of societies for thousands of years.

Up until recently bread (and often beer) made up a huge portion of people’s diets. In Ancient Egypt, state workers received their wages in bread and beer “with the average peasant receiving three breads and two jugs of beer a day” (Jacob, 1944, 31). In thirteenth century Britain the diet was almost entirely fermented: “workers on feudal manors ate 70 to 80 percent of their calories in the form of bread and cheese. Beer, essentially liquid bread made up the remaining 20 to 30 percent” (Bobrow-Strain, 2012, 4). As late as the 1950s in Europe, people

received 40 to 60 percent of their daily caloric intake in bread (Bobrow-Strain, 2012, 4).

Likewise, Americans received 25 to 30 percent of their daily calories from bread from the mid-nineteenth century until the late 1960s (Bobrow-Strain, 2012, 4).

Under these conditions of high bread reliance, “governments perceived as neglecting the bread supply faced mob violence, bread riots, and worse” (Bobrow-Strain, 2012, 4-5). While “Marie Antoinette may never have actually said ‘let them eat cake’ in respond to her subjects demand for bread,” her neglect of the bread supply may have led to one of the most famous of these bread riots, which happened in France in October 1789 (Bobrow-Strain, 2012, 5). 6000 women rioted over the high price of bread. They stole bread from the monarchy, and forced the king and queen into house arrest (Bobrow-Strain, 2012, 5). “It was the monarch’s lavish dining” when ordinary people couldn’t even afford bread “that tipped the scale toward the masses” in the case of the French bread riot (Bobrow-Strain, 2012, 5). England tried hard to prevent these kind of riots from happening with a regulation that was in place from 1266 to 1863 called “the English Assize of bread” (Bobrow-Strain, 2012, 5). This law “regulated bread sales and bakery profits. But even then, the system wasn’t perfect and bread riots erupted during moments of waning faith in the benevolence of government” (Bobrow-Strain, 2012, 5).

Beer and bread were also taxed. One part of this story is the 500 year old German Beer Purity Law or *Reinheitsgebot* in German, which mandates that only three ingredients can be used in German beer: water, barley and hops (Graber and Twilley, 2016). Yeast was not regulated when the law came into effect because it had not yet been identified; though brewers knew yeast from the bubbling action it produces. Barley was mandated to be used instead of wheat because the government wanted to save wheat for bread making. Hops, as a

mandatory ingredient replaced the myriad of bittering herbs that had been used before this time. Many of the bittering agents, used in pre-*Reinheitsgebot* German beer are known to have had psychoactive properties. Even when they did not have a psychoactive effect, they tended to be energizing, as opposed to the mildly sedative effect of hops. As was the case in the example of the bread riots, beer shows that the ruling class has used fermented foods as a means to placate and control their citizens.

### *Salt*

The need to add dietary salt is also something that happened as humans moved away from hunter-gathering societies and toward settled agricultural societies. Hunter-gatherer people tend to get their sodium by drinking animal blood. But as meat consumption went down, and bread eating increased, there was less salt in the foods humans ate. The desire for salt was still strong. Just as Rome's empires depended on sophisticated bread production and distribution systems to flourish (Bobrow-Strain, 2012, 4), they also depended on the quest for salt (Kurlansky, 2002).

Before salt, food preservation was much more limited; most fermentation isn't possible without salt and neither are salt-meats or salt-vegetables (where food is preserved in such high levels of salt that it cannot ferment). Boethius describes that fermented fish was only possible because of both the cold period Northern Europe was going through at that time, and because it was a non-saline ferment. People did not yet have salt or salt-preserving technology (though there was salt in certain foods), so they couldn't use salt to aid in the fermenting process. Without salt (and without the aid of refrigeration technologies), fish could only be fermented in

Arctic temperatures. Otherwise, it would go too far and just rot. The line between “well-fermented” and “rotten” is a slippery one, and is definitely very culturally specific (see appendix IV). Sudan is known for its large number and diversity of fermented foods, with over 80 different ferments (Sheppard, 2000, 131). Sheppard’s description of the fermented meats of Sudan sounds very much like what we in the West would call rotten. One example of these fermented Sudanese meats is called *Shermout*. *Shermout* “is made of dried and fermented strips of meat, hung inside the house until it has a very strong ‘rotten’ taste and sometimes is even maggotty” (Sheppard, 2000, 131). Likewise, the famous fermented Icelandic whale meat *kæstur hákarl* is known to smell and taste so strongly of ammonia that it is washed down with a high-proof vodka-like beverage. From what I hear, it is an acquired taste. Sandor Katz (2014), has described how it took him a few tries to acquire a taste for fermented shark. Katz is definitely a ferment lover and not squeamish about what others might consider “weird” foods. Both the fermented whale meat and some of Sudan’s fermented meats are fermented without salt (Diar 1992).



→ A vegetable fermentation project gone rotten.

We do not know when the first records of salt-mining and refining started, although the first records are in China in 800 BC, and more salt refining techniques came in 200 BC (Graber

and Twilley, 2016). Salt not only allowed humans to ferment and otherwise preserve foods a lot more effectively, it is also an essential nutrient: “it’s the mechanism by which we communicate between cells and all that surrounding fluid. So, without an adequate sodium intake, life is not possible” (Alderman, as quoted in Graber and Twilley 2016). The introduction of salting ferments greatly reduced the likelihood of them going bad, and of harmful bacteria taking over. However, from my understanding, at first many foods were not fermented as much as they were just *preserved* in salt. If you add some salt, it slows down rotting and the foods ferment instead. But if you have enough salt, fermentation cannot occur because salt levels that are too high are inhospitable to bacteria (Davidson, 2014). The word “salad” is a Roman term meaning “salted vegetables” (Kurlansky 2002, 54), though to what degree vegetables in Roman times were eaten fresh and salted, heavily salted for preservation, or fermented is lost in the threads of time.

Even though at first some people were heavily salting instead of fermenting their vegetables and other foods, salt’s role in fermentation revolutionized what could be fermented and how long it could be stored. One major fermented food in Roman times was olives, which need to be fermented in order to be edible (Kurlansky, 2002 67). Around this time other fermented foods, including brined fennel, asparagus, and cabbage, were also produced (Kurlansky, 2002, 67). Salt as a table condiment was rare in those days and instead was added in the form of *garum*, a fermented fish sauce that used salt in the fermentation process (Kurlansky, 2002, 79). Vegetable fermentation continued to be popular after this time, and both dry salt and brine methods were used. By the middle ages “the huge nation of Russia had a considerable demand for salt, *especially to preserve meat and vegetables* through the long

and barren winter” (Kurlansky, 173, italics mine). The most common fermented vegetables in the middle ages from Alsace to the Urals were fermented cucumbers and cabbage: pickles and sauerkraut.

Because salt was so important for food preservation, nutrition, and even cloth dying, it was a force that shaped politics and built empires. From Rome’s colonialism to the salaries that soldiers were paid, it was all salt (Kurlansky 2002, 53). In fact, both the words “solider” and “salary” also come from the Roman word for salt (Kurlansky 2002, 53). Roman empire building and colonialism progressed because of the vast need for salt to supply to their peoples. Salt works were built around Europe and, over time, a region’s prosperity depended on whether it was salt-rich or salt-poor (Kurlansky, 2003). In the Gastropod podcast episode “Salt Wars,” Graber and Twilley describe how Venice was built on salt (2016). Venice was a salt-rich area, and salt was a heavily taxed item. With the money from the salt tax, the canals and beautiful architecture in Venice were constructed (Graber and Twilley, 2016).

### *Early Histories of Fermentation*

In the article “Something Rotten in Scandinavia: The World’s Earliest Evidence of Fermentation,” archeologist Adam Boethius describes how in 2016 new archaeological evidence of the earliest example of fermentation was discovered. This evidence was found in the Sweden in an area called Norje Sunnasund, from the period between 7600 and 6600 BCE (Boethius 2016, 171). This was surprising to archeologists, because people from this time period were thought to be hunter-gatherers, and fermentation and food storage generally indicate a more sedentary people (Boethius 2016, 171). Most non-alcohol fermentation that is

done in warmer climates requires salt as part of the fermentation process to slow down the growth of pathogenic bacteria while allowing beneficial bacteria to acidify the environment. However, in colder environments, non-saline fermentation is possible as the cold preserves like a refrigerator or freezer does (Boethius 2016, 179). Boethius' research shows that the fish could only be fermented if the people fermenting it lived in an area with Arctic temperatures, like the Inuit today who still practice non-saline fermentation (179). The hypothesis is that there was a cold period that lasted around 40 to 100 years that would put the area within the coldness range needed for non-saline fermentation (179).

Recent research has shown evidence of wine in France (Germano 2017) and sake in Neolithic Northern China (Graber 2016) at the same time period, around 7000 BCE. The presence of sake in Neolithic Northern China indicates evidence of fermented rice, fruit and honey, as what scientists call a "protosake" (Graber 2016). The particularly amazing thing about this early evidence of sake is that, unlike in wine or fish fermentation, fermenting any sort of grain requires an extra step in order to access the sugars in the grain "because rice's sugars are too tightly bound up as starch, and yeast can't ferment them" (Graber 2016). What this likely means is that koji was being used as a starter culture in 7000 BCE. Koji (or *aspergillus oryzae*) is a mold that is grown on partially or fully cooked rice. After being grown on the rice, it becomes high in enzymes, and then the koji undergoes a secondary fermentation where the enzymes ferment something else, for example soybeans for miso, roasted wheat for soy sauce, or more rice for sake (Graber and Twilley 2017). The use of a starter culture this far back is rather incredible and shows evidence of more advanced fermentation techniques a lot earlier than was previously thought possible.

## **Industrialized fermentation**

Historically, much of fermented food production was women's work, including beer and yoghurt. From beer to yoghurt and beyond, the industrialization of fermented foods brought these processes out of the realm of the home and of women's work and into the realm of science and men's work. This transfer of work in many cases led to the delegitimization of women's labour in producing these foods. During the infamous witch trials from the 15<sup>th</sup> and 18<sup>th</sup> centuries many female brewers, also known as ale wives, were among the powerful women burned as witches (Hester 1996, Ehrenreich and English 1973). Before the introduction of hops in beer, many other herbs were used in brewing. These herbs were added for their flavouring, bittering, and medicinal effects. In this way, beer acted as a tincture, taking the place of vodka (or other hard alcohol) that is used today to extract and make bioavailable the medicine from the herbs. This herbal medicine component along with the threat women posed because of their knowledge and as brewers, led to the connection between women brewers and witches (Hester, 1996, 304). According to Marianne Hester, these women brewed their ales in cauldrons, wore pointy hats as a marketing tool, and used a broom stick as a sign showing their house sold beer (Hester, 1996, 304): hence the modern stereotype.

The industrialization of fermented food broke off the tradition of fermentation as an embodied form of knowledge. Following Lisa Heldke (1992), Maya Hey writes about fermentation as a form of cooking that is a "mentally manual activity" that integrates mind and body in order to catalogue senses into experience (Hey, 2017, 25). "I can hear when a batch of beer is 'done' with its primary fermentation, and my hands know when a batch of bread has been sufficiently kneaded" (Hey, 2017, 25). Likewise, with sauerkraut and kimchi I make, I can

taste when it's sour enough to be done (for me), and I know how the cabbage should feel before it goes into the jar to ferment. With yoghurt, I am learning to feel what the optimal temperature milk temperature is to add the yoghurt starter (or backslopped yoghurt) to it.

With the industrialization of fermented foods, however, we lost a lot of these embodied knowledges. Instead of fermenting by touch, taste, smell, hearing, and sight, fermentation became strictly measured, using lab-made bacterial starters, thermometers and strict timelines. The separation of head and hand-work goes along with the “Cartesian philosophy and Enlightenment notions of Self privileging intellect over manual labour. Further, this separation is deeply gendered, where ‘mind is rendered equivalent to the masculine and body equivalent to the feminine’” (Grosz, 1994, as quoted in Hey, 2017, 25). So, fermentation was taken out of the kitchen, out of the realm of women in which it was a “mentally manual activity” and into the realm of the laboratory where it became scientized. It became a process that was categorised as either a mental or manual activity, instead of both together.

Fermentation is a cyclical process. This is best demonstrated in the process of backslopping that yoghurt and other ferments used. However, commercial lab-made yoghurt cultures lack the biodiversity of traditional, heirloom yoghurt and can only be backslopped two or three times before the culture is no longer viable (Katz, 190-191). Part of the kinship of fermentation is the time involved; the waiting and checking and the continuous perpetuation of culture; industrialization often shortens these fermentation processes, and removes the hands-on element.

Yoghurt was industrialized in larger Bulgarian cities in the 1920s and 1930s, though it was not until the 1950s that this industrialized yogurt had reached smaller towns and rural

areas (Stoilva, 2014, 99-100). It had been a product made on farms, primarily by women, before this time. In Bulgaria, male scientists then scientized the process. This was done after observing women partaking in traditional yoghurt making:

These academically trained authors claimed this [the yoghurt method they wrote down after observing the women] was the traditional method. However it was how West[ern] European scientists understood the practices of yoghurt production employed by peasant women and shepherds. Despite trying to be accurate the scientists' description actually transformed the technology. (Stoilva, 2014, 46)

Before yoghurt became industrialized, there was a sense of magic involved in its making: before it was inoculated with the backslopped *maya*, “magical words, drawing a cross over the milk, and producing special sounds” were used to ensure the success of the *maya* (Stoilva, 2014, 97). Yoghurt-making went from being produced with magic in large five kilogram batches and backslopping with *maya* to scientists re-interpreting recipes made at home so that only small batches of precisely 300 grams could be produced, where exact proportions of starter culture were needed and thermometers had to be used (Stoilva, 2014, 45). With the scientists' interpretation of the women's yoghurt making practice, the flexibility of making yoghurt with the amount of milk available (from your animal) was lost, as was the embodied knowledge relationship between the women and the yoghurt, milk, and bacteria.

In the beginning of yoghurt industrialization, the backslopping technique was still used, however later on laboratory-made yoghurt starter cultures began to be developed and employed. Male scientists deemed these laboratory-made yoghurt cultures to be safer than traditional women-dominated home yoghurt making because of the *purity* of the cultures. The reasoning seemed to be that without unknown bacteria, “pure cultures” were safer. Much of this logic stems from a Pasteurian narrative (see Latour 1988), where there is a belief in the

overall danger of microbes. It seems like scientists believed that the laboratory-made “pure” starter cultures were safer, and that they were protecting people from the dangers of unknown bacteria in traditional yoghurts.

These unknown bacteria were seen as scary and dangerous. This outlook fits with the mindset that stemmed from Pasteur and was popular at this time (if not universally held, see Latour, 1988): bacteria are inherently bad unless proven otherwise. Of course, this makes sense, as bacterial-disease epidemics have killed thousands and sometimes millions of people around the world. The pre-WWI period was the twilight zone between the discovery of bacteria and the development of antibiotics. In this period, was there any actual evidence that industrialized yoghurt was safer, healthier, or otherwise better than traditional yoghurt? Or was it merely propagating the belief that scientifically produced yoghurt *had* to be better than traditional yoghurt because it was produced in a standardized, repeatable manner within sterile environments?

### **Pasteur and Pasteurization: Bacterial Microbiopolitics**

What Louis Pasteur is most known for is, of course, the pasteurization process that was named for him. While it's most often used in milk, it can be used in fruit juices, alcohol, and other foods including eggs and other solid foods as a means of preservation. Pasteurization is part of the process of canning. Louis Pasteur himself used the process to preserve the flavour and to increase the shelf life of wines (Shephard, 2000, 212).

To understand the changes Pasteur's scientific revolution made to fermentation, it's necessary to understand how his revolution came about and what it entailed. Bruno Latour

discusses four ways Pasteur changed biology, medicine and hygiene (1988, 8). First, Pasteur's "revolution took place at the high point of the scientific religion" (Latour, 1988, 8): people were replacing a belief in (Judaean-Christian) religion as a place of certainty in their lives with a belief in science. Second, "no one except extreme cynics can doubt the value of Pasteur's discoveries to medicine" (Latour, 1988, 8): preventing children from "dying from terrible diseases [can't be] seen as anything other than an advantage, except of course to the microbes of those diseases" (Latour, 1988, 8). Third, the speed at which it all happened was quite incredible: "in no other scientific or technological innovation has there been such a short cycle between fundamental research and its rapid, far-reaching application" (Latour, 1988, 8). Fourth, Pasteur changed medicine from an art to a science by finally applying the scientific method to the field (Latour, 1988, 8).

However, it was not just Pasteur who was doing this research; there were many other scientists working on what would later be called Pasteurian research. It was not just science, but all of society that was in the midst of transformation. "If the whole of Europe transforms its conditions of existence at the end of the last [nineteenth] century, we should not attribute the efficacy of this extraordinary leap forward to the genius of one man" (Latour, 1988, 15). The Pasteurian revolution was a major turning point in fermentation history because it led us to understanding not only what microbes are, but also their role in medicine and food storage and preservation is. Interestingly, early canning technologies were developed before the understanding of this science. Nicholas Appert patented the canning technique and won a prize from Napoleon for presenting the Navy with a better way to preserve food on ships in 1809 (Shephard, 2000, 222). It was another 50 years before Louis Pasteur described the science

behind canning, and started using (what is now called) the pasteurization process, in 1861 (Shephard, 2000, 212).

Around the time pasteurization started being used, microbes were described and at first being projected as harmful. An 1877 quote from John Tyndall shows to what degree bacteria were viewed negatively: “for centuries...we have been struck by invisible scourges, we have fallen into ambushes, and it is only today that the light of science is reaching those terrible oppressors” (as quoted in Latour, 1988, 10). Those “terrible oppressors” that Tyndall refers to are, in fact, microbes. Tyndall, in viewing microbes as “those terrible oppressors” seems to have a particularly one-sidedly negative view of microbes. While it was held by many in Pasteur’s time, it was definitely not universal, even though it often appears that way now. In 1885, Loeys wrote that “we need the assistance of the infinitely small” (as quoted in Latour, 1988, 37). Sternberg even discusses microbes in terms of helping us digest: “we can hardly doubt the importance of the role played in the individual by those table companions that help it to break down organic substances” (329, as quoted in Latour, 1988, 37).

Interestingly, by Pasteur’s time, microbes had already become safer because of their domestication. The domestication of koji (*aspergillus oryzae*) from wild *aspergillus* varieties had already happened. While wild *aspergillus* makes dangerous defense chemicals called secondary metabolites that are toxic enough to kill humans, in the domesticated koji, these secondary metabolites have been bred out, and modern koji harbours none of the dangers of its wild cousin (Graber and Twilley, 2017). Not only is today’s koji less toxic, it is also more efficient at breaking down rice than earlier varieties (Graber and Twilley, 2017).

## **Bacterial Anxieties and Antibacterial Capitalism**

Recently there has been a growing awareness of the problems with the overuse of antimicrobials (commonly referred to as antibacterials). The broad scientific consensus is that we are overusing antibiotics and that antimicrobial resistance is caused by excessive use in both human health and animal industries. Further, the overuse of antibiotics for non-therapeutic use in farm animals is causing human health concerns, as the Antimicrobial Resistance (AMR) has crossover from animals to humans (Landers et. al, 2012, 4). There is an increasing number of human infections that are resistant to all major classes of antimicrobial drugs (Canada, 2014, 4). Luckily there is evidence that reducing animal use of AMs that are medically important to humans, can reduce AMR in a very short time (Wielinga, Peter R., et al, 2014).

One of the major problems with both Antimicrobial drugs as well as antibacterial cleaners and hand soaps is that they kill 99.9% of bacteria. While that sounds good, 99.9 percent of bacteria is *almost* all the bacteria; the problem is what happens to the 0.1 percent. The 0.1 percent of bacteria that survive become stronger and more able to resist antibacterial soap and cleaners over time; in addition, we also end up killing good bacteria in the process (Katz, 2012, 13).

Augustine Zegers photograph “Filthglycerin” show a clear pump-bottle of hand soap filled with debris, dirt and leaves and comments on the problems with antibacterial soap (2017, 109). Zegers discusses how handwashing does not actually do much in terms of getting rid of bacteria on hands (2017, 108). In describing this piece, Lauren Fournier, curator of the exhibit “Fermenting Feminism” in which this piece appears, notes:

the anti-bacterial imperative, which has encouraged the wide use of hand sanitizer and antibacterial soap in both public institutions...and private spaces...in the name of staving

off illness and disease, ignores the fact that human bodies are constituted by a multitude of symbiotic relationships with bacteria (2017).

We can think of the microbes in fermented foods, as having a similar entanglement and symbiotic relationship with human bodies. Both human relationships with fermented foods and “Filthlycerin” both point to the impurity that makes up human-microbial relationships.

Today’s post-Pasteurian attitudes are only possible because we are literally “post-Pasteurian.” What Paxson and Helmreich mean by this is that an “optimistic vision of microbes has been enabled precisely by the fact that the Pasteurian project has been so successful; microbes can be promising for those who no longer have to worry about smallpox, polio, cholera, and other agents of infectious disease” (2013, 19). Part of the reason we are “post-Pasteurian” is that we have actually overcome many of those infectious agents (Paxson and Helmreich, 19), making many of the remaining bacteria less scary.

In 2014, I attended a court hearing for Michael Schmidt. He is a raw milk farmer who is famous for standing up to the Canadian government’s anti-raw milk laws. This court case is emblematic of the opposing arguments we often find today around fermented and other microbe rich foods like raw milk. Part of the problem is that the Post-Pasteurian underground and the Pasteurian government regulators are not just diametrically opposing forces, they are in fact playing two different games. Where Pasteurians fear bacterial contamination, illness, and infection, Post-Pasteurian raw milk supporters follow the same logic as vegetable fermenters, who argue that diversity of bacteria leads to a healthier, safer ferment.

These two regimes of hygiene may be termed the Pasteurian and the post-Pasteurian. While Pasteurians view raw milk-cheese as a biohazard, potentially riddled with bad bugs, post-Pasteurians regard it as the inverse: a traditional food processed for safety by the action of *good* microbes- bacteria, yeast and molds- that can outcompete bad bugs for nutrients in milk. (Paxson and Helmreich, 2013, 8)

One thing I emphasize to people in my fermentation workshops is the safety of the process. Workshop participants are often quite nervous because of the associations they make between fermentation and vinegar pickling. With canning, including making vinegar-based pickles, there is always the risk of botulism if a high enough degree of acidity is not achieved (from the bacteria *Clostridium botulinum*, or *C. botulinum*, which makes deadly spores). If the process is not executed properly, *C. botulinum* takes advantage of an oxygen-free, low-acid environment, with no competitors, as the competitors have been wiped out by the boiling process to thrive (Katz, 2012, 338). This is exactly the kind of environment you find in canned foods, particularly low-acid and low-sugar canned foods. *C. botulinum* can survive in normal boiling temperatures for up to 11 hours (Katz 2012, 20); this explains the precautions canning guides take in advising pressure canning for low-acid fruits, vegetables and meats.

Even though, *C. botulinum* is a soil bacterium and commonly found amongst the bacteria on vegetables, botulism is not a concern in fermentation because of the acidity, salinity and diversity of the bacteria in fermentation environments.

Ten percent salt-content—extremely salty—inhibits the growth of *C. botulinum* at typical ambient temperatures and a neutral PH. Much lower salt concentrations can inhibit *C. botulinum* and other pathogenic bacteria when used in combination with acidification, cool temperatures and/ or limited drying. (Katz, 2012, 340)

In fermentation, it is in fact the *diversity* of bacteria, along with salt content, that creates an acidic and safe environment. One example of this safety in diversity is in raw milk cheese where “the diversity of raw-milk cheese can facilitate ‘good’ microbes outcompeting ‘bad’ ones” (Paxson and Helmreich, 2013, 169).

*C. botulinum* comes from the same family as *C. difficile* (or *Clostridium difficile*). While *C. botulinum* thrives in an environment of canning gone wrong, where all other bacteria have been eliminated from the jar, *C. difficile* tends to particularly thrive in humans who have wiped their bacterial slate clean through multiple courses of antibiotics, for hard to treat bacterial infections like MRSA (Methicillin-resistant *Staphylococcus aureus*) and other bacterial infections that are resistant to many antibiotics. Because of this, it is most prevalent in people with compromised immune systems, particularly in hospitals. Both *C. difficile* and *C. botulinum* come from the *Clostridium* family and are specialists who survive and thrive in environments where their competitors have been wiped out. There is obvious irony in the fact that precisely the supposedly safe environment of the hospital enables the success of *C. difficile*.

Likewise, for *C. botulinum*, it is canned food (particularly non-acidic home-canned food) where they have free rein. However, when *C. botulinum* exists within either the diversity of the soil or a fermentation crock, it isn't a particularly strong presence and doesn't dominate the environment. In a fermentation crock or jar, it is both the diversity of bacteria and the acidity of the environment (which the other bacteria have promoted) that causes botulism's demise. By itself, in a sterile canned environment, *C. botulinum* can take over and wreak toxic havoc— one millionth of a gram of botulinum's spores are deadly, and they are the only bacteria left after their spores have survived lengthy periods of boiling (Katz, 2012, 338).

Overall, even if government food safety regulations still skew towards the Pasteurian, we have changed the way we talk about bacteria in the past thirty years. In 1986 when Thorne discussed fermentation, he wrote that “the most convenient way of preserving food was to encourage the growth of *harmless* bacteria or other micro-organisms in the food in the

exclusion of those that would cause food to become harmful or unpalatable” (15, italics mine). I found this to be an interesting use of the word “harmless” because these bacteria are known to be more than just harmless, they are beneficial. If this passage had been written today it would have probably have said “beneficial” or a similar term. This would particularly be the case if you were a post-Pasteurian today. There is a significant difference in terms of designating something as harmless/neutral instead of good/helpful.

From reading Latour’s work on the history and social context of Louis Pasteur, it seems like scientists of Pasteur’s generation has a vision of microbes was in fact, far more nuanced than we give them credit for today. Scientists in Pasteur’s time understood that we needed microbes for their help with digestion and other processes (Latour, 1988, 37). But by the Cold War, attitudes towards microbes had become much more embedded in war imagery and thus an anti-microbial attitude flourished. From sterility of food to invasion of alien species, “these concerns were saturated with Cold War imagery” (Paxson and Helmreich, 2013, 14). One example of this war imagery can be seen through industrialized food was industrial white bread advertisements in the 1950s. Bobrow-Strain describes one such 1953 advertisement entitled “Reach! Mom... It’s Loaded,” which was an “ad for Jane Parker enriched white bread, portraying a cowboy-hat wearing, pistol-wielding [reminding] readers that bread was ‘loaded’” (2012, 126; “loaded” referred to vitamin and mineral supplementation). Today, our framing of microbes has changed: from space to ferments, “microbes are no longer looked upon as enemies but as welcome companion to contemporary human cultural projects” (Paxson and Helmrieck, 2013, 15).

## **Microbes as Companion Species: Embracing Kinship?**

To me, what makes fermented foods our companion species is that for the most part they would not exist without humans. In turn, humans also rely upon these microbes. Both vegetable and milk fermentation makes our food more digestible and capable of being stored for longer periods of time. Grain fermentation brings us the twin food gods of bread and beer. While grain fermentation does not allow grains to be stored for longer periods of time than dried grain, it does have other benefits. Turning grains into bread through fermentation makes the grains more nutritious as it improves bioavailability of the nutrients in the grain, and makes it easier to digest. While beer, as another form of grain fermentation, does not have the same dietary importance as bread, it is enjoyed by many people and can be a safe beverage in places where water is not potable. Beer and other alcoholic ferments are so well-loved that in different cultures there are dozens of beer and wine deities. In vegetable fermentation, we manipulate the environment that the bacteria on the vegetables grow, by adding salt, chopping the vegetables in a variety of different sizes, as well as by controlling the temperature at which the fermented vegetables are. In many ways, our microbial companions are not just companion species, but co-evolutionary partners. As Haraway writes:

Co-evolution has to be defined more broadly than biologists habitually do. Certainly, the mutual adaption of visible morphologies like flower sexual structures and the organs of their pollinating insects is co-evolution. But it is a mistake to see the alterations of dogs' bodies and minds as biological and the changes in human bodies and lives, for example in the emergence of herding or agricultural societies, as cultural, and so not about co-evolution. At the least, I suspect, that human genomes contain a considerable molecular record of the pathogens of their companion species, including dogs. Immune systems are not a minor part of naturecultures; they determine where organisms including people live and with whom. The history of the flu is unimaginable without the concept of the co-evolution of humans, pigs, fowl and viruses. (Haraway, 2016a, 122)

One particular food that comes to mind when I think about companion species and ancestral co-evolutionary partnerships is koji (*Aspergillus oryzae*), as discussed earlier: It was only through the selective breeding and co-evolutionary history of humans and koji that *Aspergillus oryzae* became the well-loved microbe and co-creator of delicious foods that it is today (Graber and Twilley, 2017).

In vegetable ferments, for example in cabbage, we humans create the environment for lactic acid producing bacteria to reproduce and proliferate. The lactic acid producing bacteria varieties of *leuconostoc* and *lactobacillus* are not the only bacteria that naturally occur on cabbage, but they are the ones that are selected for fermenting cabbage. In addition a fermentation environment for say sauerkraut, is one where salt acts as an inhibitor for harmful bacteria. As the various LABs (Lactic Acid producing Bacteria, mostly various species of *Lactobacillus*) take over the environment in succession, the environment changes and becomes progressively more acidic. The environment allows some diversity, but gradually grows to favour different LABs that can tolerate higher and higher acidity levels. These acid levels also act as inhibitors to *C. botulinum* and other pathogenic bacteria that can cause food poisoning illnesses in humans. The initial fermentation environment is home primarily to varieties of *leuconostoc*, which acidify the environment. As the sauerkraut environment becomes more acidic, varieties of *lacto bacillus* and *pediococcus* dominate (Pundir and Jain, 2010, 221). This is species companionship, as the various varieties of lactic acid bacteria work together to acidify the environment, making it more hospitable to the next more acid tolerant variety.

Although cheese and sauerkraut making are different processes, both go through a process of bacterial succession. Benjamin Wolfe and Rachel Dutton have studied cheese and its

microbial communities and found that it follows similar succession patterns as happens in forests (Wolfe and Dutton, 2015). In cheese, forests and other ferments, succession always follows the same patterns. First, there are pioneering species. Over time, these pioneering species change the environment, making it more hospitable to the next organisms. Dutton and Wolfe explain the process as one where

most fermented foods go through a clear and relatively consistent process of ecological succession with early colonizing microbes being replaced with one or more succeeding microbial groups. In some systems, such as the fermentation of cocoa pods and sourdough fermentation changes in the environment caused by early colonizing species and metabolic cooperation between functional groups are underlying drivers of these successions. (Wolfe and Dutton, 2015, 52)

Studying bacterial succession is useful in a few ways. First it takes a lot less time to study the succession of microorganisms, who operate on a timescale of days, weeks and months, instead of the years, decades and centuries it can take for forest succession. Studying bacterial succession therefore aligns better with the lifespan and timescale on which humans operate. However, studying bacteria is not just useful at an abstract scientific level. It is also useful in a more practical food safety context. The famous cheese-making nun Noella Marcellino's experience and research with cheese-making, showed that using a stainless steel container for holding the cheese-making milk in, instead of the more traditional wooden barrel, is in fact more dangerous. This is because in the stainless steel container, the milk is not acidified as quickly, which allows pathogenic bacteria to more readily thrive in the less acidic milk environment. She even inoculated both barrels with *e-coli* and found that the *e-coli* died in the wooden barrel while thriving in the stainless steel container (Bilger, 2002). What happens in the

wooden barrel is that the bacteria that live in the wood more quickly acidify the milk, which then forms an inhospitable environment for pathogenic bacteria.

Some people use a starter culture to ferment vegetables. This starter culture allows the kimchi or sauerkraut, for example, to skip over the pioneering species of LABs (lactic acid producing bacteria) and acidify the environment more quickly. While this does speed up the process of fermentation, it does not help with the flavour or texture. In fact, skipping over the initial stage of the fermentation process can make the vegetables less crisp and the flavours less nuanced (Battack and Azam-Ali, 1998). This is because starter cultures tend to be quite acidic.

Battack and Azam-Ali explain that:

If the starter juice has an acidity of 0.3% or more, it results in a poor quality kraut. This is because the cocci which would normally initiate fermentation are suppressed by the high acidity, leaving the bacilli with sole responsibility for fermentation. If the starter juice has an acidity of 0.25% or less, the kraut produced is normal, but there do not appear to be any beneficial effects of adding this juice. Often, the use of old juice [or backslopping] produces a sauerkraut which has a softer texture than normal. (Battack and Azzam Ali, 1998, 5.6.2)

To me, what this says about companion species relationships is that they take time, and rushing the process does not result in a better fermented product.

### **Contemporary Fermentation Politics**

Contemporary fermentation politics is a fraught and diverse field. One major tension is between what I call traditional or folk fermentation and scientific fermentation practices.

Traditional fermentation practices tend to be followed on a smaller home-based scale, while scientific fermentation practice tend to be used on a much larger, commercial scale. The two types of fermentation practices also tend to split along ideological lines, with traditional

fermentation falling more on the post-Pasteurian side, embracing the diversity of microbes, and Pasteurian fermenters being more concerned with having a particular blend of laboratory bred microbes.

In her book *The Life of Cheese: Crafting Food and Value in America*, Heather Paxson describes a post-Pasteurian microbiopolitics as “committed to working in selective partnership with microscopic organisms, figured as agents of a nature that is not fully objectified and never fully separate from human enterprise” (2013, 161). In contrast, a “Pasteurian approach treats the natural world as dangerously unruly and in need of human control” (Paxson, 2013, 161). While you can ferment with a Pasteurian mindset, there is still an underlying belief that overall, microbes are harmful.

In traditional fermentation (let’s use sauerkraut for an example), you salt the cabbage to taste and pound the resulting product, and then let it sit in its own juices (or brine) until it tastes *right*. While some resources from this school of thought will recommend a specific time interval, that is all it is: a recommended fermentation time frame, not a *rule*. A lot of how long the fermentation will take depends on temperature, salt level, and even UV levels. With a more scientific fermentation method, you weigh the vegetables and salt, making sure you add a specific percentage of salt, as per the recipe. Many scientific recipes also advocate using airlocks, arguing that they reduce kahm yeast (a common yeast that develops on the surface of a vegetable ferment) and other molds and spoilage. Advocates for traditional methods discuss how most surface cultures: i.e. scum, yeast and certain molds can be scraped or scooped off. For other fermenters, a disadvantage to the airlock is not being able to taste as you go along. In other words, it impedes your ability to use your senses to know when a sauerkraut will taste

best in your environment. I understand the advantage of following more rigid scientific methods when you are scaling up fermentation. You do not want to (and in many cases, *cannot*) do commercial production if you do not have a reliable product. However, the necessity for this sort of practice is otherwise debatable.

In *Wild Fermentation*, Sandor Katz suggests fermenting sauerkraut for anywhere between three days and three months or more (Katz, 2016, 52). However, when Katz writes this he is also accounting for the fact that people's tastes, along with the temperature and humidity level of their living environment, vary. Going beyond taste, Paxson writes about how safety can also be different at the individual level, as a "food can be healthy and safe for some individuals but not for others" (Paxson, 2013, 167). In contrast, a scientific article on sauerkraut gives a much stricter approach of when sauerkraut is best/ safest to eat. Pundir and Jain suggest sauerkraut should be eaten on or before the 28-day mark, and that after this point, it becomes overrun with dangerous molds and other pathogenic bacteria (Pundir and Jain, 2010, 224). However, as this is a scientific study, Pundir and Jain make sure to keep their sauerkraut at a specific temperature range between 21 to 24 degrees Celsius (2010, 222). This in fact goes above the temperature range suggested as ideal for sauerkraut fermentation of 18 to 22 degrees Celsius (e.g., Howe 2014). However, at a lower temperature sauerkraut also ferments more slowly. The temperature variation in traditional fermentation, both between seasons and between different geographic locations and homes means that the suggestion of 28 days as a point of safety is often not true considering the different variables of the home environment. The 28 days that Pundir and Jain recommend as the point of sauerkraut safety does not really make sense because they do not test the sauerkraut between the 28 day and 60 day mark

(2010, 224). So, while it is no longer safe to eat when they test it at the 60 day mark as fungi have begun to grow and the sauerkraut is starting to spoil, it seems overly cautious to advise not eating it after the 28 day mark (Pundir and Jain, 2010, 224). From my experience with sauerkraut making, there are likely some points of safety and deliciousness in between the 28 and 60 day marks. To me this seems like a reason to use science as a guideline, as opposed to a rule, along with using your senses and getting to know your home environment, as the home fermentation environment will likely vary from that in a laboratory.

## **Conclusion**

As I have explored in this chapter, through examples such as complicated companion species relationships between sauerkraut and colonialism, as well as the sexist history of the industrialization of fermentation foods, fermentation is intrinsically intertwined with these complicated histories. Viewing these relationships as intertwined and complicated, helps move towards a politics of messy impurity.

Viewing fermentation through a lens of impurity helps us to let go of control. Full control over our microbial companions is impossible. Learning to work with them instead, not only bring us delicious foods, it also is a more just way of relating to all beings. How would this intertwined history of complicated companion species relationships have been different if we had collaborated instead of fought? Can we use the ethos of fermentation to move towards a future of more just relations with other humans and more-than-human beings?

**Chapter 2**  
**Making Kin with Sauerkraut (and Kimchi): Fermentation Workshops and Companion Species Relationships**



Photo taken by Ronit Jinich of my hands massaging cabbage for sauerkraut

## *Introduction*

I would say that wild fermentation (or traditional) fermentation is impure. Unlike, say, a commercial yoghurt strain where there's only one possibility of how things can ferment, wild fermentation has more possibilities: I am thinking of *Leuconostoc* slime in beet ferments, unintentionally sour but delicious beers, and komboucha getting over-sour and then used for vinegar instead. I am also thinking of compost as a part of the fermentation process. And of Noella Marcellino's wooden cheese-making barrel and how it goes against the idea of sterility as safety: the diversity of bacteria on the surface of cheese can protect against pathogenic bacteria spoiling the cheese. I am thinking of the history of home yoghurt production and the starter culture *maya* in Bulgarian yoghurt. Elitsa Stoilva, in her Bulgarian yoghurt thesis: "Producing Bulgarian Yogurt" (2014), describes how sometimes the *maya* would fail (though yoghurt makers used religious rituals and magic to try and prevent this), and then they would just borrow some *maya* from a neighbour. I am also thinking of a childhood book about turning mistakes into opportunities. The messiness of fermentation can make it impure. The messiness of these microbial-human relations can make fermentation workshops and fermentation a different way to think about bacteria. This notion of impurity can be an important aspect of how we relate to and think about bacteria.

Fermentation activities and fermentation workshops can serve as important discursive spaces to rethink this relationship. In terms of the microorganisms in our bodies, "we are all already polluted. We have more microorganisms in our guts than cells in our bodies- we are crawling with bacteria and we are full of chemicals. We are in other words, continuous with

everything here on earth. Including, and especially each other” (Biss, as cited in Shotwell, 2016, 10).

To explore the practical politics of making impure kin with bacteria, I conducted two fermentation workshops, one creating sauerkraut community, and the other creating kimchi community (see Appendix II and III). The sauerkraut workshop took place at the Stop Community Food Centre on October 12, 2017<sup>1</sup>. The kimchi workshop happened the following week on October 17. In the workshops that I describe in this chapter, I move away from theories and histories of purity, kinship, and fermented communities, and toward a practice of building companion species relationships with our fermented foods, in community. In this chapter, I describe the methodology and pedagogy of the two workshops I facilitated, including contrasting the different class, gender and educational backgrounds of my two workshops participant groups. I also look at the results of these workshops, and how they demonstrate a way in which to meld theory and practice, making companion species relationships with the ferments we make.

### **The Workshops**

I have facilitated over a dozen fermentation workshops in the past, but these two fermentation workshops got deeper into the companion-species theory I outlined in Chapter One. I wanted to see if fermentation workshops could change people’s ideas around bacteria, as well as looking at the pedagogy of teaching embodied knowledge. One of my goals in the fermentation workshops I teach is always for participants to be able to go home and repeat the process.

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<sup>1</sup> The poster I used to advertise for the workshop is in appendix VI

Learning how to demonstrate, teach and speak about embodied learning more effectively involves participants getting their senses involved, but it also helps them be able to go home and repeat the process. This embodied knowledge making in the workshops helps to create a space of relationality between the vegetables, the microbes and us humans, as well as between people. The workshops are also a journey in learning how to trust ourselves, each other, and our embodied experiences.

For me, learning to ferment has been a journey in learning to trust my fingers and my tongue. In many ways, this trust is a means of developing intimacy with food and, particularly, with ferments. In my workshops, I try to counter the common belief that fermented foods are difficult, require specialized equipment, or should be left to the “experts.”<sup>2</sup> While some ferments *are* more difficult than others, it does not mean that they cannot be produced at home by anyone who is willing to put in the effort. While some ferments require a sharper learning curve than others, through experimentation and learning about the quirks of your home environment, they can become easier over time. When I first made sauerkraut, it seemed hard to believe that my punching, kneading hands would ever release enough brine out of the cabbage leaves. Trusting in the process is part of the journey to learn how to ferment, gaining embodied knowledge and building community.

The two workshop spaces I chose for hosting these fermentation workshops were The Stop Community Food Centre’s emergency food services location, and the Crossroads Gallery in

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<sup>2</sup> This de-centring of the notion of expertise was something I really drew on. Sandor Katz’s 2003 book *Wild Fermentation* includes phrases such as “Do not be afraid. Do not allow yourself to be intimidated. Reject the cult of expertise. Remember that all fermentation processes predate the technology that made it possible for them to be complicated” (Katz, 2003, 35).

the Faculty of Environmental Studies at York University. Part of the reason I chose the Stop as one of my workshop locations was because I had connections there from working there in the summer of 2015. The Stop's clientele tends to be low-income and marginalized. In the spirit of food justice, another reason I chose the Stop as a location as I wanted to make the fermentation workshops available to people who might not otherwise get to participate in these kinds of workshops. The final reason I chose the Stop as one of my workshop locations is that I naively thought that I might be able to recruit participants who did not have a fermentation or microbial knowledge background (though this turned out not to be the case, nor was it as important as I had initially thought). Initially, I chose the Crossroad Gallery as a workshop space because I wanted to host workshops as part of my research and I was only able to book the Stop for one workshop. I was worried that my academic peers would have too much prior knowledge to work well as participants in the discussion. I think in both cases, my own fermentation expertise and microbial knowledge blinded me from the fact that most people (regardless of their background or social status) have not thought that much about either fermentation or microbes.

### *Workshop Methodology*

The fermentation workshops I facilitated were based on a similar fermentation workshop facilitation style I have used in the past. I drew on popular education methodology and aimed to empower workshop participants with the skills and confidence to repeat the fermentation process at home (for either kimchi or sauerkraut), as well as to trust their senses as to when the ferment is ready. One popular education methodology I used was storytelling. In both

workshops, I told stories of my own fermentation learning experiences. I do this to connect with participants and their cooking and social backgrounds and try to de-centre myself as expert. The other popular education methodology I used was praxis. The fermentation workshop experience is an embodied learning experience, workshop participants are learning through practice. This practice was combined with theory in the form of discussion connecting bacterial succession and bacterial companion species relationships in the fermented foods we produced. I hope that the knowledge, skills and embodiment explored in these workshops led to workshop participant empowerment in their home practice.

When I was organizing the sauerkraut workshop with a Stop staff member, I was told that they didn't want to use knives in the drop-in centre. So, I pre-chopped the cabbage and took it to the workshop, and it was like a cooking show in terms of how fast the process went. We ended up having more time than we needed rather than less, which has often been a problem I have had with workshops in the past. While I prefer to have participants involved in the process of massaging the cabbage, adding salt and spices and pounding it into a jar allows them to get a good idea of the process. The kimchi workshop at Crossroads Gallery involved participants in everything except making the rice flour paste, which I made with the help of a volunteer just before the workshop so it would have time to cool before it was needed in the process. Apart from that, however, the participants chopped, grated, minced, massaged, and pounded the vegetables and added the red pepper paste before putting it into jars for fermenting.

For both workshops, I used the same discussion questions, although the questions that resonated with the group varied between the two groups. The discussion questions are

included in Appendix I. The major rationale behind the discussion was to have an opportunity to discuss the theory behind the fermented practice we had embarked on together. The key trajectories of the questions were whether the workshop had made them think differently about bacteria. With this question, I was wondering if fermentation workshops could be a space that could counter antibacterial anxieties that are common in our culture. The other key theme was about embodied knowledge, I wanted to know how workshop participants felt about going home and judging with their senses when the kimchi or sauerkraut they had made was finished fermenting.

One of the lessons I learned from both workshops was to present the discussion questions throughout the process rather than at the end, since participants seemed tired or ready to leave at the end. Interspersing questions with the process would have also not created an artificial divide between the workshop's hands-on activities and conversation/discussion.



A collection of sauerkraut I have fermented, in workshops and with friends

### *Workshop # 1: Sauerkraut*

The sauerkraut workshop took place at the Stop Community Food Centre at the Davenport Road location from 1:15PM to 3:00PM on October 12, 2017. Eight people attended the workshop, though a few more people came at the beginning and grabbed handouts.

Amongst the workshop participants was a man who seemed to be developmentally delayed, and a man who had very limited English skills. It seemed that these participants struggled with some of the more theoretical parts of the workshop. There was only one female participant, all others were men. When I advertised for the workshop a week earlier at the Stop, I went around to each table during breakfast to let people know about the workshop and hand out flyers. At the workshop, I wondered why the participant profile was so heavily

skewed towards men, and whether the fact that there were so many men in the workshop space meant that the women who otherwise attend Stop programs felt less safe in the space, and thus did not come?

In the lead-up to the workshop I was extremely nervous and under a lot of stress. The time slot for this workshop had become available with very little notice, and I had to prepare quickly. It also meant that I had to switch gears rapidly from writing about companion species to workshop preparation. Being compelled to work on a more hands-on activity made me anxious, as I did not feel that I was ready yet. I was also nervous about how the discussion would go. I was concerned whether enough people would show up. There were too many unknown factors congealing at the same time. My anxiety was neither helpful nor necessary, but in the end the workshop went well. What the experience taught me was that it is no longer a question of whether I can facilitate a fermentation workshop, but of how well. I need to remember that while the physical elements and logistical requirements of a workshop are important, my mindset and mental preparation are equally integral to the process.

The physical environment we were in also added to my anxiety. The workshop was not held at one of the kitchens at the Stop, but in the drop-in room. The drop-in is a large room at The Stop where anyone is welcome to come enjoy a free hot breakfast or lunch. However, the room tends to be filled with homeless and low-income individuals enjoying these free, hot, healthy meals. Meals are served restaurant style by Stop volunteers and staff around circular tables where Stop clients sit with friends, acquaintances and strangers. The next room over houses the waiting area for the Stop's food bank. Housing these emergency food services, the 1884 Davenport Stop location is the less trendy and gentrifying Stop location. At 1884, it's not

middle-class white people talking about food justice, it is poor people enacting it through access to food, as well as through advocacy, activism and skills training. Part of the reason I thought a fermentation workshop would fit in at the Stop is because they already host many cooking classes, so I thought I would find interest in the space in another type of food-making practice.

The Stop is a rather chaotic place. The drop-in space resembles a public-school lunchroom and is full of hungry people, many of whom have mental health issues. But by the time my workshop had started, most non-workshop participants had cleared out and the space was a bit calmer. The workshop followed what seemed like an extra-busy lunch. Unfortunately, this frenetic feeling did not entirely stop once my workshop began in earnest, as one the Stop's clients was yelling at Stop staff members in the same room. This altercation happened right when we were in the thick of the workshop. We tried to knead, smash, and punch the cabbage, and talk about sauerkraut amidst the noise. However, because of the loud and chaotic environment, I could not explain the process as well as I would have liked.

Additionally, I only had (Stop) staff support toward the end of the workshop, as the staff member who was supposed to be supporting my workshop was on her lunch break for the first half of the workshop. Given the format of my workshop, I didn't really need staff support at the end of the workshop when we were more focussed on the discussion, but rather at the beginning when the process was more hands-on, and participants were asking me a lot of questions. I probably could have asked for the staff member to take her break later but coming into the workshop, I hadn't anticipated what level of support would be ideal. Facilitating fermentation workshops is still a learning process and I get better every time. I want to

continue this improvement in workshop facilitation. This includes asking for help, and being able to present my workshop to a variety of audiences, all the while making the experience as accessible as possible: both physically, psychologically, and academically.

Accessibility was one of the areas on which I received feedback. The one woman who was part of the workshop said that she would have participated more if that workshop had been made more physically accessible. The workshop set up required people to stand, gathered around a counter space. I wanted people to be gathered close by, so I could hear them and effectively communicate. I was particularly worried about being able to hear people well because of both the yelling in the background and because of my unilateral hearing impairment. However, prioritizing my own accessibility meant my workshop was less physically accessible for people who had mobility issues and couldn't stand for long periods of time.

The workshop discussion did not go as I hoped it would. It was hard to get people to stay to the end to have a discussion, and not everyone who stayed had the vocabulary to answer the questions or add to the questions in a way that was useful. Most simply answered "yes" or "no." One man whom I knew from the community garden I had worked at before dominated the discussion amongst the sometimes nonsensical contributions from other workshop participants. He also had a bit too much prior knowledge of fermentation to really be a good fit for the workshop. He sat at the outskirts for most of the workshop. He seemed to suggest that he already knew enough about fermentation so that it wasn't useful for him to come to another workshop. However, he did end up coming for the discussion. He spent part of the discussion reading things he had found off the internet about fermentation. He talked about fermentation like it was both a gospel and a medicine, and was convinced that

fermented foods and beverage had curative powers. He talked about how it helped him get over the flu in three days and that “the guy who gave ... [the flu] to [him] was sick for two months...It makes a big difference... if you boost your immune system *you’ll never get sick*” (D, 12 Oct, 2017, italics mine).

At some points in the discussion, I doubted to what degree participants had learned from the workshop, as one participant still seemed to be confusing canning and fermentation. Another reason the discussion was not as effective at this workshop, was that I had laid out the questions in another room, where my extra workshop materials lay. However, given that I didn’t have workshop support staff until the very end of the workshop (and the hands-on part of the workshop took *less* time than I thought it would), I didn’t feel like I could leave the room to go to the nearby office and pick up the discussion questions.

This workshop taught me to be more prepared for the possibility of things going wrong in a workshop. I know one thing I could have done differently was to have double-check that I had *everything* I needed (including the workshop discussion questions) laid out before the workshop started. This workshop also caused me to reflect on the different expectations I have in comparison to the workshop participants expectations. For me, the workshop felt like a bit of a failure because of both the yelling that happened in the middle of workshop, as well as the discussion, going less well than I hoped it would. For the most part, however, workshop participants seemed happy with the experience, and at the end of workshop discussion, one workshop participant said excitedly “hopefully you can come again” (12 Oct. 2017). I think sometimes in these situations I need to lower my expectations. Things are never going to go perfectly, but perfection, as I have learned from Shotwell, is never the answer.

### *Making sauerkraut in a complex community*

For the sauerkraut workshop, I pre-chopped around four heads of green cabbage at home the night before. I had only done this for a workshop once before. Pre-chopping the cabbage in preparation for the workshop forced me to measure the cabbage in a more exact way than I typically do for making sauerkraut, i.e., often I just weigh the cabbage and other vegetables in the store and then estimate what the weight will be after the cabbage has had its heart and outer leaves removed. I weighed the cabbage rather than measuring it because it is more accurate and easier that way. It is important however, if you are going to weigh the cabbage (for an accurate weight), to weigh it after it has been stripped of its outer leaves and heart. I was worried that pre-chopping the cabbage would dry the cabbage out, especially if I chopped the cabbage too early, and so I chopped, weighed and bagged the cabbage the night before. The cabbage was roughly chopped and put into large Ziploc-style bags. After weighing and observing how much cabbage fit into a 500-millilitre jar, I filled each bag with just under one pound (or approximately four cups) of cabbage. Optimistically, I prepared twelve bags of cabbage for the workshop.

We started the workshop by talking about sauerkraut. The participants had a lot of questions, like what sauerkraut is, what we were going to do in the workshop and what kind of foods they could eat the sauerkraut with. After the questions, we moved on to making the sauerkraut. Before we got started, I told the workshop participants to wash their hands and put on aprons. Then I offered everyone a taste of sauerkraut from the two samples I had brought. One sample was new and had only been fermenting for two days. After two days of fermentation, the sauerkraut tastes more like a wilted, salty coleslaw than sauerkraut proper.

The two-day old sauerkraut had cabbage, salt and whole black peppercorns in it. The other sample had fermented for around three weeks and had been stored in my fridge for two months. It was made at a sauerkraut workshop I hosted at Maloca Community Garden as part of my Graduate Assistantship in August. It had mostly green cabbage, along with one red cabbage, whole black peppercorns, smoked garlic, and dill from the garden. I wanted the participants to sample both the old and young sauerkraut to give them an idea of the changes in taste the fermentation process brings to the cabbage, from salty cabbage to sauerkraut. Most participants preferred the older sauerkraut.

After we sampled the sauerkraut, I told workshop participants what the sauerkraut process would entail. I told them it was physically similar to bread-making, and asked if any of them had made bread before; it seemed like most had not, so this comparison worked less well than I had hoped. I thought this comparison might have worked better than it had, as many Stop cliental are involved in Stop community cooking groups (in fact, many of the workshop participants, went to the Stop's Men's Cooking Group directly after my workshop). The process involves chopping the cabbage (in this case, it was pre-prepared), and then pounding, kneading and massaging the salted cabbage to release its juices and create a brine. For the one pound of cabbage that each workshop participant was given, they were advised to each use two teaspoons of salt, which they pounded in large bowls.

Often in fermentation workshops, I have found the measuring of salt to be chaotic and tedious because this means you also have to measure or weigh the cabbage to achieve a good ratio. For this reason, I often advise people to add salt to taste. But for many, this can be a daunting instruction, especially if they prefer being able to follow an exact recipe. What often

ends up happening in a workshop where I advise participants to “salt to taste” is that they end up asking me to taste their sauerkraut to figure out if it is appropriately salted. I do not see this as necessarily a bad thing; however, I worry about it being an impediment for workshop participants to repeat the process at home, and feel like it is something they should be able to learn to do without a facilitator. I would describe the appropriate salt level for a batch of sauerkraut as salty, but not too salty, like a well salted salad. I admit that this does sound ambiguous, but learning to cook and ferment by taste can also bring something important to the process. To me, it also makes the process simpler as you do not have to make sure to measure salt before making the ferment. You can start pounding the vegetables before the chopping process is completed, which can save time. This can be particularly helpful when a workshop process is rushed or short on time. That said, I do understand why many people like being given a recipe with more exact measurements. For them, it is easier to approach a new process if there are fewer unknowns.

During the workshop, I tasted some of the unfermented sauerkraut that some of the participants had made. In one instance, a man in the workshop was having trouble getting enough liquid to release as he pressed the salted cabbage into his mason jar. When I tasted it, it was distinctly non-salty even though he claimed to have put the same two teaspoons of salt into his bowl as the rest of the participants. This must have been because he had under filled the measuring spoons when he had measured out the salt. To me this shows that, because there will always be human errors, it is important to taste your ferment to double-check on saltiness and flavour. This is an especially good idea if the cabbage you are making sauerkraut with isn't releasing as much liquid as would be ideal.

The first stage of the sauerkraut process of adding salt and pounding the cabbage took about ten minutes. During the pounding process, workshop participants had many questions about what the final product would be like. Some of these questions were about the sauerkraut samples. I was asked questions like “why do they taste different from each other?” and “how can I make mine taste like that one [the older, sourer sample]?” The answer to both of these questions is: time. One sauerkraut sample had fermented for a mere two days (and was not yet finished fermenting), while the other sauerkraut sample had fermented for three weeks and was done fermenting.

Once the workshop participants had finished mixing and massaging their cabbage and salt together, they had the option to add herbs and spices of their choosing to the mixture. The herbs and spices I brought with me were whole black peppercorns, freshly dried dill from Maloca Community Garden, and hot red pepper flakes. I often also bring caraway seeds and juniper berries to add to sauerkraut at workshops. All the participants chose to add herbs and spices to their sauerkraut, most of them choosing to add all the available options. They were particularly excited about the hot pepper flakes.

At one point in the workshop, I discussed how I sometimes add other vegetables besides cabbage to my sauerkraut. They usually include carrots, radishes, garlic and beets. Adding additional vegetables to sauerkraut makes it a more like a fermented coleslaw. In sauerkraut, if you add too many sweet vegetables--particularly beets but also carrots, the sauerkraut can develop a viscous brine as it ferments. However, my experience has been that ferments with a viscous texture tend to get over this phase and develop a thinner brine, and more appealing texture with time. The research I have done suggests that this viscous brine comes from

bacteria that like to feed on sweet vegetables, particularly *Leuconostoc* and *Lacto Bacillus Brevis* (Hoffman 2013). After telling workshop participants about the possibility of this viscous brine, one workshop participant asked whether adding other non-cabbage vegetables was only for more experienced fermentation makers. I said that it was not *only* for “expert” fermenters, but that I would stick to using smaller amounts of sweet vegetables.

I also discussed how I often vary between using green and red cabbage. While in this particular workshop I only used green cabbage, I often use one red cabbage for every two to four green cabbages because I like the vibrant pink colour the mixed cabbages produce. Typically, I do not use all red cabbage in a batch of sauerkraut as red cabbage tends to be drier and more expensive than green cabbage.

During the workshop, one of the workshop participants asked about the difference between making sauerkraut with red cabbage versus with green cabbage. He wanted to know if the process was the same for both types of cabbage. I explained that while red cabbage was drier, and thus might take longer to release its brine, in general the process of making the sauerkraut does not vary between the two types of cabbage. One workshop participant was also very interested in the health benefits of fermenting with red cabbage instead of green. He asked if the sauerkraut fermented with red cabbage had more health benefits, the answer to which I did not know (at the time). Health benefits are not my primary reason for fermenting, and it is not the focus of my research. However there is research that suggests that red cabbage is healthier as it contains almost ten times more antioxidants than green cabbage, with the antioxidants coming from the cabbage’s radiant purple colour (Miller et. al, 315s).

After massaging, punching and kneading of the cabbage, the next step is to put the cabbage mixture (pre-fermented sauerkraut) into jars. In this workshop, we used 500 millilitre narrow mouth mason jars. I prefer to use wide mouth mason jars, but they are harder to find and more expensive and were not available at the store when I was purchasing jars for the workshop. . The other reason that wide mouth jars are more useful in fermentation is that the sauerkraut mixture needs to be tightly packed, avoiding air bubbles. The participants used a ladle and wide mouth funnel to scoop the sauerkraut mixture into the jars, making the process less messy. Cabbage that is exposed to air, either at the top of the jar or throughout the jar, tends to get discoloured and can even get moldy or spoil. Mold that is any colour other than white or off-white is considered dangerous. You can also tell if it has spoiled based on smell; if it does not smell like other vegetables you have made (or “pickled”), especially if coupled with mold, it is bad. In many cases, it is possible to scrape off the top half to one inch layer of sauerkraut that has kahm yeast or other white scum on it, in order to get to the better sauerkraut underneath. However, this wastes some of the sauerkraut, and some people are not comfortable with scraping off a layer as it goes against what many of us have been taught about food safety, in terms of avoiding moldy food.

There is a way to keep the fermenting sauerkraut under the brine by using a weight. Some people have specially made wood or stone weights in the shape of two half-circles that fit perfectly inside their crock. Some people also use a clean rock or stone as a weight on top of their fermenting vegetables. Sometimes I use a smaller jar filled with water as weight that fits inside the mouth of the larger jar. Similarly, you can use a plate that fits inside the mouth of the crock, and put a weight on top of the plate. In my understanding, the best container for

fermenting is a type of German crock with a water lock. There is also a similar Korean water-lock crock for kimchi.

In the workshop, we used a small Ziploc-style bag filled with brine (i.e., salt water) and placed it to fit snugly inside the mouth of the jar. While some sources suggest using a Ziploc bag filled with water as a weight, there is a problem with this method: if the Ziploc bag leaks or bursts, it will dilute the sauerkraut. This can cause the sauerkraut to go bad because of the low-salinity it causes.

I felt a bit weird about how much of an emphasis I put on the Ziploc bag and brine weight method in my workshop, as I only sometimes use a weight in my own home fermentation practice. To some degree this is just because of laziness. I have also found that most of the time, a weight is not entirely necessary. However, there have been times when I ferment at home and my sauerkraut goes bad or tastes off. But failure is part of the process. However, I wanted my workshop participants to have the best possible chance at producing excellent sauerkraut from the process. I also worry that with someone who is new to sauerkraut making (and possibly eating as well) that one bad batch might turn them away from the process altogether.



Kimchi that I made with friends and in workshops. My kimchi supply was running low when I took these photographs

### *Workshop #2: Kimchi*

The kimchi workshop took place at Crossroads Gallery in the Faculty of Environmental Studies at York University on Tuesday October 17<sup>th</sup> 2017 from 12:30PM to 2:30PM. Eight people participated in the workshop, although one participant came half-way through and one participant left at around the same time. The calmer, familiar place and people, along with the lack of chaos in the room, meant that I came into facilitating the kimchi workshop feeling fairly calm, excited, and ready for the process. I also had help with the logistics of the workshop from Lisa Myers and Kelly Lui, as well as some help from one of Kelly Lui's volunteers (who was

helping in the gallery) with setting up the space and stirring the rice paste I was making for the kimchi.

The Crossroads Gallery is a student gallery that is part of the Faculty of Environmental Studies at York University. While the room is versatile and can accommodate tables for preparing food, as well as electric outlets for plugging in the hot plate use for cooking the kimchi paste. It is not a kitchen. It has carpeted floors and no direct water access. However, the Faculty of Environmental Studies does not have a dedicated kitchen that would have worked better than the gallery, so in many ways this was as good a room as any other in the building.

The workshop and the kimchi brunch that followed were presented in conjunction with Kelly Lui's Major Research Project: a documentary entitled "Kitchen Table Conversations." As part of Kelly's documentary presentation, she had wanted to transform the gallery into a kitchen and animate the space, setting the tone for the documentary and drawing people into the space. After a conversation with Kelly about my fermentation workshops, she invited me to present a kimchi workshop, in conjunction with her major project gallery presentation. It was another venue and different group of participants to present my workshop to, as well as being a way to draw more viewers to Kelly's documentary.

Coming into this workshop I was surprisingly calm while I ran around doing last minute workshop preparations. At the workshop's starting time, not many participants had shown up, and most of the jars for the workshop were still in Lisa Myers' car. Until five minutes before the workshop's starting time there was also a meeting going on at the table on which I was waiting to set up the kimchi bowls. Part of this feeling of calm had to do with being surrounded by

peers and feeling like I had support in the process. The York environment itself was also a comfortable process as I have spent the past two years doing my Masters in this space.

In addition to the kimchi workshop at Crossroads, I also co-facilitated a kimchi and sourdough pancake brunch with Kelly Lui on Thursday October 26. We served sourdough and scallion pancakes with kimchi on top, and when they ran out, we switched to frying kimchi pancakes. The smell wafted through the hallways of the second floor of the HNES building. While some of the workshop participants came back to eat the fruits of their labour, we also had many students and faculty members drop by because it smelled so delicious. The smell seemed like an invitation that brought people out of their offices. It demonstrated the power of food to bring people together.

#### *Making kimchi in a community of familiars*

At first, I was concerned that not enough participants would show up to be able to run the workshop. At 12:30, the time the workshop was supposed to start, there were only two people who were part of the workshop: Kelly (my co-organizer) and Kristen, a MES colleague. However, within ten minutes, five more participants arrived.

Making kimchi is a more complicated process than making sauerkraut. This is because it involves more steps, and more ingredients. Many traditional kimchi recipes involve soaking Napa cabbage in a salt water brine for anywhere between one day and a week, depending on the recipe. However, this has never been a process that I have followed in either my kimchi workshops or my home kimchi fermentation practice. Part of the reason is the amount of coordination and counter space it requires (and given that I share my apartment with others, I

try not to impose this on our shared kitchen and dining space). I also prefer to have fermentation workshop participants involved in the whole fermentation process if possible, and removing the pre-soak step and therefore compressing the time-scale allows participants to enjoy a more hands-on experience. While this was not possible for the sauerkraut workshop due to safety concerns from the staff, it is an ideal situation.

I had never been sure about what the pre-soaking process that most kimchi recipes recommend is for. However, a recent post on the Facebook group “Wild Fermentation Uncensored” discussed how the pre-soaking process draws out the liquid in kimchi ingredients before they ferment. This way, the kimchi ferment is more paste-like than brine-like (Hoffman 2017). I have never minded my kimchi being more liquid / briny, but purists might differ. I wonder if, as a white person making kimchi, I am missing something. One thing I like to emphasize in my kimchi workshops is that there is no right way to make kimchi. Even within Korea, there are more than one hundred different varieties of kimchi (Katz, 2012, 112). Particularly, coming from my background a white person facilitating workshops, I do not want to give the impression that my way of making kimchi is the *only* or *best* way to make kimchi. In the workshop discussion, Kelly Lui emphasized how she appreciated me saying how this was just *one* way to make kimchi, saying “what... stood out to me is when Michaela clearly stated this is how I make kimchi amongst the other ways to do it” (Lui, Kelly, 17 Oct. 2017)

The main ingredient we used in the kimchi was Napa cabbage. We coarsely chopped the cabbage, though many traditional kimchi making recipes call for whole Napa cabbage leaves to be used. Next, we mixed in grated carrots, daikon radish, burdock root, breakfast radish, and salt. The burdock and horseradish roots were left over from a herbal medicine workshop I had

attended at Maloca Community Garden the previous week. Simultaneously, the workshop participants grated ginger, horseradish, and garlic. The ginger, horseradish and garlic were set aside separately for the kimchi paste. One of the workshop participants put some of the ginger directly into the bowl with the main kimchi ingredients. When I told her that the ginger was supposed to go into the paste with the horseradish she was worried that she had ruined the process. We tried to rescue as much of the ginger from the top of the main kimchi ingredients bowl as we could. However, I told her that it did not matter that much in the end, as all the ingredients would eventually become mixed up in the same jars and then bowls.

Like in the case of sauerkraut, after the main kimchi vegetables (Napa cabbage, carrots, radish and burdock) were chopped and grated, I advised the participants to add salt to taste, and massage, knead and punch the vegetables. In both the sauerkraut and kimchi making processes, the vegetables should taste salty, but not so much so that the level of salt is unappetizing. It tends to be easier (and less necessary) in kimchi than sauerkraut to use salt to get the vegetables to release their juices (not that the salt itself is not necessary, just in a different way). This is because Napa cabbage is softer and juicier than its green cabbage counterpart. After we punched, kneaded, and massaged the main vegetables together, we added a few sheets of torn up nori to each bowl. Most kimchi recipes call for either fish sauce or dried fish, or both. In my workshops, because I try to make the process more accessible to vegetarian and vegan participants, I replace the umami fishy taste with the seaweed instead. Nori seems to be a good alternative and makes the kimchi taste more well-rounded than it would without it.

Another part of making kimchi is making the red pepper (or *gochukaru* in Korean) paste. The base ingredient is rice flour (although I have often used rice ground in a coffee grinder when I am pressed for time and don't have ready-made flour), cooked with water in a saucepan. The ratio is two to three tablespoons of rice flour for every cup of water. The paste is cooked on low heat and stirred frequently. You can tell the paste is done cooking when it reaches a thin, porridge-like consistency. After this point, you let it cool to a temperature of "finger hot," or until it is on the verge between hot and warm. Learning what this temperature felt by having participants touch the paste as it was cooling, and giving feedback about what this temperature was supposed to feel like from me as a facilitator was really helpful for workshop participants integrating of this embodied knowledge. In the workshop discussion, Katherine remarked that "to pick up how hot's that paste or how much stuff should I put in or having an in-person thing is much more useful for that" (Katherine, 17 Oct. 2017). Having people gain the embodied knowledge of subtle differences in temperature, adds a much different quality to the fermentation process than just using a thermometer. In any case, this temperature is similar to that used to dissolve yeast into water in bread making, as well as the temperature at which yoghurt starter is added to milk in yoghurt-making. The exact temperature in the case of kimchi is not important. What matters is that it is not *too* hot to kill the lactic acid producing bacteria on the garlic and ginger (etc.) that will be added to the paste.

Although the participants were not there for the initial making and stirring of the rice paste, they were there as we waited for it to be cool enough to add the other ingredients. Once it was cool enough, we added the grated ginger and horseradish, as well as the minced ginger; we then added the red pepper powder. As I normally do in my kimchi making practice,

we added red pepper powder in a ratio of two to three tablespoons per cup of water. While using this ratio as a guideline, I often determine the amount of red pepper powder by how vibrantly red it makes the paste. The red pepper powder should be a bright orange-red colour, not a pastel pink-orange. After adding all the ingredients to the paste, it should be stirred to evenly distribute them; at this point, the paste is ready. In the workshop, I pre-made the paste with the help of a volunteer. I chose to do this to save time because of how long the paste takes to cool.

After all the kimchi vegetables, seaweed and kimchi paste are mixed together, the pre-fermented kimchi is packed into jars or a crock. At the workshop, we used a variety of jar sizes. We filled the jars using a wide-mouth funnel and a ladle. The kimchi we had prepared filled nearly five litres worth of jars. In most workshops, I ask workshop participants to fill small to medium sized (250- 500 mL) jars with the vegetables to be fermented, so they can take them home. However, at this workshop we left all the jars at the Crossroads Gallery to ferment, so they would be ready for the kimchi pancake brunch that Kelly Lui and I hosted for the closing event.

I now realize that I should have told Kelly and the gallery volunteers who would be opening the gallery space in the week after the workshop about *how* kimchi behaves as it ferments. Kelly frantically texted me a few days after the kimchi workshop to tell me that jars of kimchi were overflowing. This is *not* unusual kimchi behaviour. Usually, when I ferment sauerkraut or kimchi, I put a plate or tray underneath to catch the overflowing brine. This is the reason kimchi should be allowed to ferment in non-metal material (stainless steel is acceptable), as it will contaminate the ferment and ruin the metal container.

### **Discussion: Fermenting in Different Communities**

The participants who came to the kimchi workshop were already interested and engaged in learning and participating. Many of the workshop participants were friends and acquaintances who wanted me to succeed in my research; they were also intellectual peers, whose journeys were similar, in many ways, to mine. It also took place in a university setting where people are more used to participating in workshops and research. In contrast, at the sauerkraut workshop I facilitated, it seemed like participants wanted to come and take what they could for themselves, but were not giving a lot back in terms of workshop discussion. This could have been partly because of the marginalized status of that group. One of the teaching possibilities this made me think of, was the possibility of collaboration with workshop participants about what they want to get out of the workshop. This fits into the Popular Education ethos that I like my workshops to have, and it might make for a workshop discussion that is more successful as it connects back to participant experience and interest. This style of collaboration did not necessarily make sense for the type of workshop discussion I had planned for these workshops, but it is useful to keep in mind for future workshops.

### *Fermentation Pedagogies across Communities*

When I reflected on the two workshops, I wondered if the workshop I facilitated for the university participants (a group of peers) felt more successful because I explained the workshop and theories more thoroughly for the university audience. Besides the fact that I knew many of the workshop participants in the kimchi workshop, I think I was also less hesitant discussing

theory with this group because I felt like we spoke (educated) English. In the sauerkraut workshop, not only was I not surrounded by graduate students, some of workshop participants did not even have fluency in English. Of course, the distraction caused by a Stop client yelling at Stop staff made it a less optimal teaching environment as well. Another aspect of Stop research was that I struggled to explain what my research was and what I was trying to accomplish. In the kimchi workshop, there was less of a need to explain that my workshop was part of my master's research, as given that they were a university audience (and many of them students or recently students), most of them probably had a better idea of how research works, or having participated in it or conducted it themselves before. I definitely feel like the first workshop allowed me a chance to figure out how to best present a fermentation workshop that includes discussion; and this second kimchi workshop benefitted from this.

### *Fermentation Workshop Field Notes*

What follows are the edited fermentation workshop findings. They are broken up in to sections based on both questions I had asked and other important themes that the discussion illuminated. Through these sections I highlight themes that tie the workshop back to the rest of my paper. These include embodied knowledge(s), companion species relationship, different time scales of fermenting, microbial succession and health and safety.

#### “How do you feel about figuring out when things are ready?”

Since we live in a society where many of us are re-learning traditional practices such as fermentation, we build trust with experimentation. One participant, (who I will refer to by the

pseudonym D) in the sauerkraut workshop who had a prior home fermentation practice (making sauerkraut among other things) described his process of figuring out when things are ready to *his liking*. I asked “how do you know; how do you figure out when your things are ready?” He responded:

With that one [the green cabbage sauerkraut] I could tell by the colour...With the red one, I kind of just let it go, I know I like it more than two weeks so I leave it a month... And then I know that I can't go wrong. If it's sour enough... it goes in the fridge, and if it's not it goes back over there, and then I try it another week, if it's sour enough... it goes in the fridge, if not it goes back to where I have it. (D, 12 Oct 2017)

In the kimchi workshop, I asked a similar question, “How do you feel about going home and repeating the process?” Kelly Lui responded:

Though I am extremely excited to continue fermenting and despite the openness of the workshop, I still feel uncertain if I can do it alone. It was interesting to use my senses to figure out if things looked okay or to determine what something was. Yet I still need a lot of practice or experience to feel that I know. (Lui, Kelly, 17 Oct. 2017)

Not everyone in the workshops felt that newness and openness of the process made it intimidating. In the kimchi workshop when I asked “how do people think about the openness of the process and the recipe?” Michelle, another participant responded: “I loved it! I thought it was great. I personally feel intimidated going to these cooking classes where they have a more formal structure, but here you're with your peers, it's really open, not afraid to ask you any questions and it made it not intimidating” (Michelle, 17 Oct. 2017).

This embodied knowledge of going home and being able to repeat the process speaks to fermentation as a means to build companion species relationships. Both the long time-scale and uncertainty is part of this process. Michelle discusses the ‘open structure’ and the freedom to ask questions that she felt in my workshop. This lack of fear often means that mistakes are

part of the process. Making mistakes and getting enmeshed in the messiness of the process is part of a politics of impurity.

“How do you feel about judging by your senses?”

For Katherine, a participant in the kimchi workshop, the fact that it was an in-person workshop mattered a lot in terms of learning how to interpret the ferments through your senses:

Well, I do find having the in-person demo as an experience is really, it really helps a lot with that because then it can be, if it was just on paper or something or even just on a video, it's so much harder...to pick up how hot's that paste [is] or how much stuff should I put in having an in-person thing is much more useful for that (Katherine, 17 Oct. 2017).

In the kimchi workshop, Kristen went on to say “I like that you encourage us to taste things and smell things. I think it would be more useful next time for us” (Kristen, 17 Oct. 2017) I got a sense from the workshop participants' feedback, that in order to learn how to interpret a ferment with your senses, the in-person workshop where we learn with our senses is really helpful.

The following conversation took place between me and one of the sauerkraut workshop participants, who I'll call John. He was trying to get a grasp of what the sauerkraut should look like as it is fermenting. I talked about how you might get some scum (or kahm yeast) on the sauerkraut if the cabbage is not pressed down. I said “you want it to be pressed down.” He responded, “Just a little.” I said, “you want the liquid to go above the vegetables.” He queried, “above the cabbage?” I responded, “yeah, you'll see that you have the cabbage liquid a little bit above the vegetables.” Wanting to make sure, he asked, “above the cabbage?” and I respond “yeah.” Once again, he asked “a little bit?” and I respond “a little bit. You'll see that you have the cabbage liquid a little bit above the vegetables. See, look at this [pointing to a jar of

sauerkraut I am holding], you want it to be little bit like that.” Seeming to understand these instructions, he responded, “like that, just a little bit.” (John in conversation with me, 12 Oct. 2017).

To me, part of what this kind of conversation reveals is the importance of an in-person workshop for confirming and encouraging what workshop participants learn from hands-on experience. While John seemed like a pretty nervous, soft-spoken man, he also seemed excited to try to make sauerkraut again at home. Because of his nervousness towards the process, I felt like without my guidance to direct him towards *what* the sauerkraut should look like in the jar, he would not have felt confident in making it. Before asking about how the sauerkraut should look like in the jar, John had asked about whether or not he could ferment it in a clean, plastic peanut butter jar. D was adamant about the dangers of fermenting in plastic. While I prefer to ferment in glass, I think it is probably better to encourage an interest and openness to fermentation, than to enact a politics of purity around plastic; which is only one of the many things in our environment that might leach toxic chemicals. What is the use of telling a workshop participant who probably cannot afford to buy jars for fermenting to tell him they are the *only* reasonable way to ferment?

#### Human-bacterial Companion Species Relationships

At one point in the sauerkraut workshop, D quite aptly described human-bacterial companion species relationships: “It’s like a symbiotic relationship.... Same with companion gardening, yeah, it does the same thing, it protects the plants from diseases and bugs... So that’s what’s the beauty of nature right?” (D, 12 Oct. 2017). To me, the symbiosis between humans and our

microscopic companion species is at the heart of understanding these relationships. In the kimchi workshop, Kristen echoed this idea when she said “the nuance that you talk about it with is really interesting. Like calling bacteria by name and saying that if you shortcut you don’t get the intensity of flavours, just like the intimacy at different stages and types, it just gave me a lot more depth. It was cool” (Kristen, 17 Oct. 2017). From my small sample size of people in these two workshops, I gathered that people seemed open to and interested in thinking about bacterial relations differently.

One way this openness and interest in different modes of thinking about bacterial relations was enacted was through participants coming to a participating in a fermentation workshop. In the sauerkraut workshop, one participant was disappointed that we had not worn gloves in the massaging of the cabbage. As we had already washed our hands for the workshop, this seemed unnecessary. This seems like the type of antibacterial fear I was hoping might be re-thought in the workshops. Part of why I wanted workshop participants to look at bacterial relations differently is because of the growing crisis in anti-microbial resistance. Could a change in thinking about bacterial resistance lead to a change in action, on an individual, community or policy level?

In the kimchi workshop, I asked workshop participants if they had “any thoughts on bacteria and if [they’d] thought differently about bacteria from participating in the workshop?” For Michelle, one way the workshop made her look at microbes differently, was “to not be afraid to make it. I think I was afraid to make kimchi because I didn’t want to screw up the ratios. I didn’t know you could be a bit more experiment-y for lack of a better word, in terms of how much salt to add and stuff like that” (Michelle, 17 Oct. 2017). Also in the kimchi workshop,

Kristen discussed how the workshop helped her view bacteria in a different light: “when you think about bacteria you often think about them negatively. It’s nice to hear about the positive side.” Billy, another participant, did not just voice how his thinking had changed, but also remarked upon the element of taste. The workshop made him think about good bacteria and the flavours they contribute: “The learning what the good bacteria taste like from tasting it... it’s a totally different taste from [canned] pickle[s] (Billy, 17 Oct. 2017).

Judging by your senses also means interacting with these fermented foods as living beings. In the sauerkraut workshop, Katherine described this different way of thinking about food as living:

I really appreciate talking about the bacteria and also talking about the fermentation process in such an active way, like feeding it and putting it to sleep and burping it; and we’re just not used to thinking of our foods as living. We’re used to thinking of our foods as products of things that were living and now they’re dead, so it’s really different and interesting to think of it as something that is alive and doing things and it’s kind of like a relationship. It’s like a give and take. (Katherine, 17 Oct. 2017).

It seems that the relationality that we want to develop with our food and our eating comes from taking the time to see through these longer-term projects. It goes along with the intimacy of learning the names and getting to understand the bacteria families that make up fermented foods, as well as from the care that goes into tending to these ferments. This care, intimacy and kin-making is a way to build these companion species relationships.

### Time scales of fermented foods

Part of developing different relationships with fermented foods is realizing that they operate on different time scales than we are used to for food. In the kimchi workshop, Katherine said:

I guess kimchi for me is this kind of like a mysterious food where it's like, I like kimchi, I don't know how it's made... so coming to the workshop and it seems like such a long term process, and I'm more used to cooking where it's like maybe like an hour and a half, half an hour, and then you have something that's done and you can eat it. (Katherine 17 Oct. 2017)

In the sauerkraut workshop, D commented on both the mysteriousness and the long time scale of the fermentation process. We talked about the activity and the fact that a vegetable ferment bubbling over can be intimidating for some people who are just starting out.

D however exclaimed excitedly "It's a mini volcano!" and went on to say:

It [the activity, the bubbles, the vigour of the ferment] makes me excited about wine making. Like my favourite time, the first week when the batches are brewing, it throws off so much carbon dioxide man...I love the fermentation process. That's the exciting part...Yeah it like gets the sound action and quiet action and then all of a sudden it's kind of quiet, and then it's like a month before you get the fruit of your work, so you have to be patient yeah too. (D, 12 Oct. 2017)

I responded to D's comment with the comment that "yeah there's definitely more patience, it's not all just the instant gratification that people are accustomed to, it's like wait a few weeks... It'll be ready." D likened this patience to learning tennis: "It's kind of like in tennis, there's a learning curve and lots of people don't want to dedicate the years it takes to get even decent. Right, we're an instant gratification society now" (12 Oct. 2017).

### Bacterial succession

Part of the reason fermentation needs to operate on a different time scale than we are used to with fermented foods, is that they transform over time through a process of bacterial succession. One woman, who I will call Taylor in the sauerkraut workshop guessed that a starter culture could be used to kick-start the fermentation process. This was said in the context our

discussion about how sometimes fermented foods get *too* sour for your liking. She said: “If it gets over-sour, couldn’t you just mix it with a fresh batch and ferment it, that’s what I would do” (Taylor, 12 Oct. 2017). I responded: “You could do that.” To which she said: “Yeah I would just mix it with something fresh and then add more salt water. You know what I mean, use it like a starter” (Taylor, 12 Oct. 2017). I explained that the problem with this is that while “you can use it like a starter... it jumpstarts the fermentation and the flavour isn’t necessarily as [it would be] if you just do it from [scratch]...”

If the workshop had been less hectic, I might have got to discussing how her idea of using a starter does work for a lot of ferments, like sourdough, komboucha, yoghurt, cheese and many others, but is not necessary for vegetables. Vegetables that are used in fermentation have lactic acid producing bacteria on their surface, so once salt is added to the ferment to discourage bad bacteria before the ferment acidifies, it is an ideal fermentation environment. Some milk ferments, like certain cheeses or buttermilk did not originally use a starter culture but require one if you are using pasteurized milk, as it no longer has the milk’s *lacto bacillus* and other native bacteria in it. The reason people want to use a starter when fermenting is because they want to ensure their ferment turns out as well as possible. It can also be about having control over the process. Moving away from an industrialized fermentation process and back towards a ‘traditional’ fermentation process, we do not always need to have complete control over the process. What can be gained when we let go of this control?

### Health and safety

A big part of food safety and preventing food poisoning from the foods we eat, is not eating foods that have gone bad. Many people do not use their senses to judge this and just look for 'best before' and expiry dates on packaged food. However, in fermentation, you need to develop an understanding of when a ferment has gone bad because there is no label to tell you otherwise. At one point in the kimchi workshop discussion, Billy, who is Korean and had immigrated to Canada as a child, said:

Can I ask you a kimchi question? With really old kimchis, sometimes there's this white mold that forms, usually on top, and lots of bubbling happens. When you notice it, yeah, if it's really bad you could probably tell, but if it's just mold and looks okay...The white part can be scraped off. (Billy, 17 Oct. 2017)

The white mold that Billy spoke of sounded to me like what fermentation books and online fermentation discussion groups call "kahm yeast." I wondered if Billy, as a Korean immigrant to Canada had had more experience with kimchi and had learned to judge what makes a dangerous versus safe mold, in a way many of us do not learn.

At one point in the kimchi workshop, Katherine said "I think it's interesting to think of fermentation as a way to counter so much of the modern approach to food in terms of like, what's safe to eat... Oh there's always expiry dates and you've got to trust the stamp on the box instead of your own senses of is it still okay or not" (17 Oct. 2017). Another kimchi workshop participant who I'll call Jenn discussed her recent experience in a food safety course learning about expiry dates.

There was a food safety course I took and they were explaining to us the 'best before' dates and technically there's all the items, they're all 'best before' dates so it means that if you eat them before this date you can still guarantee they'll taste good, but the only food products that actually contain expiry dates are baby formula and supplemental meal products... [because in these cases] if you don't get the nutrients... than like they could die, and I was like I don't know... I didn't know that. (Jenn, 17 Oct. 2017)

Fermented foods can allow us to think differently about what a “best-before date” or a food item going bad means. However, fermentation is also a means of preservation, so it allows foods to last a lot longer before going bad. What going ‘bad’ means in the case of fermented foods is interesting. While, in some cultures, maggoty meat or cheese are considered delicacies, it can be hard to convince fermentation workshop participants that scraping off mold off the top of a ferment is okay.

### Health and purity

Another part of maintaining health is using preventative and curative medicines and treatments to stay healthy. D made it very clear that he believed fermented foods were medicines that could cure and prevent disease. He spent almost five minutes of the workshop discussion reading off an article in an online magazine called “Healthy Foods USA” on his tablet. D started by reading buzz-phrases like “Cabbage, new secret weapon against heart disease and cancer” (12 Oct. 2017). Then he moved on to slightly more in-depth information “Prescription drugs can be hard on your body and even cause side effects. But all natural products provide nothing but nutritious, health benefits. Let’s take fermented foods for example. Fermented foods aid digestion and help prevent cancer” (D, 12 Oct. 2017). The way both the article D was reading and his framing of the idea was that prescription drugs are *entirely* bad and fermented foods are *entirely* good. Although D acknowledged that the microbes in fermented foods can form these symbiotic relationships with us (for example, when he compared fermented foods to companion species gardening), he still put fermented foods on a purity pedestal.

It was not just cancer: D believed that fermented foods can cure the flu. At one point he said “I think it’s important to know that if you’re sick for more than a couple of days, your immune system is not great. Something like this [referring to sauerkraut] will correct it, eh?” (D, 12 Oct. 2017). Skeptically I said that “It helps”, and D responded that it helped him

Get over the flu in three days man...the guy who gave it [the flu] to me was sick for two months...It makes a big difference... if you boost your immune system you’ll never get sick. You may get sick once in a while, but the duration is much shorter than other people, and I used to think that it was age that does it. (D, 12 Oct. 2017)

I tried to counter this idea that just because he got better within three days when his friend took two months to get over the same illness, it does not mean that it is necessarily the sauerkraut that is healing him from the flu. Correlation does not equal causation. I went on to say how “different people’s bodies work differently, it’s not like sauerkraut is necessarily going to help me get better faster.”

While I tried to counter D’s quasi-religious beliefs in fermented foods, it did not always work. At one point in the workshop, another participant asked me about using sauerkraut as a cure for the common cold: “I have a question. What would happen if I maybe got a fever?” To which I responded “A fever? Why would you get a fever?” Another workshop participant interjected, “like the flu?” I then asked “So are you suggesting you could get sick from eating it [sauerkraut]?” The workshop participant responded “no” and then asked “Is sauerkraut good for the common cold?” (Kennedy and other workshop participants, 12 Oct. 2017). It really seemed like he had picked up this notion of fermented foods as curative from D. It made me uncomfortable that D’s workshop feedback was pushing fermented foods into the realm of purity politics and miracle cures. So, I responded to this comment with “sauerkraut can be

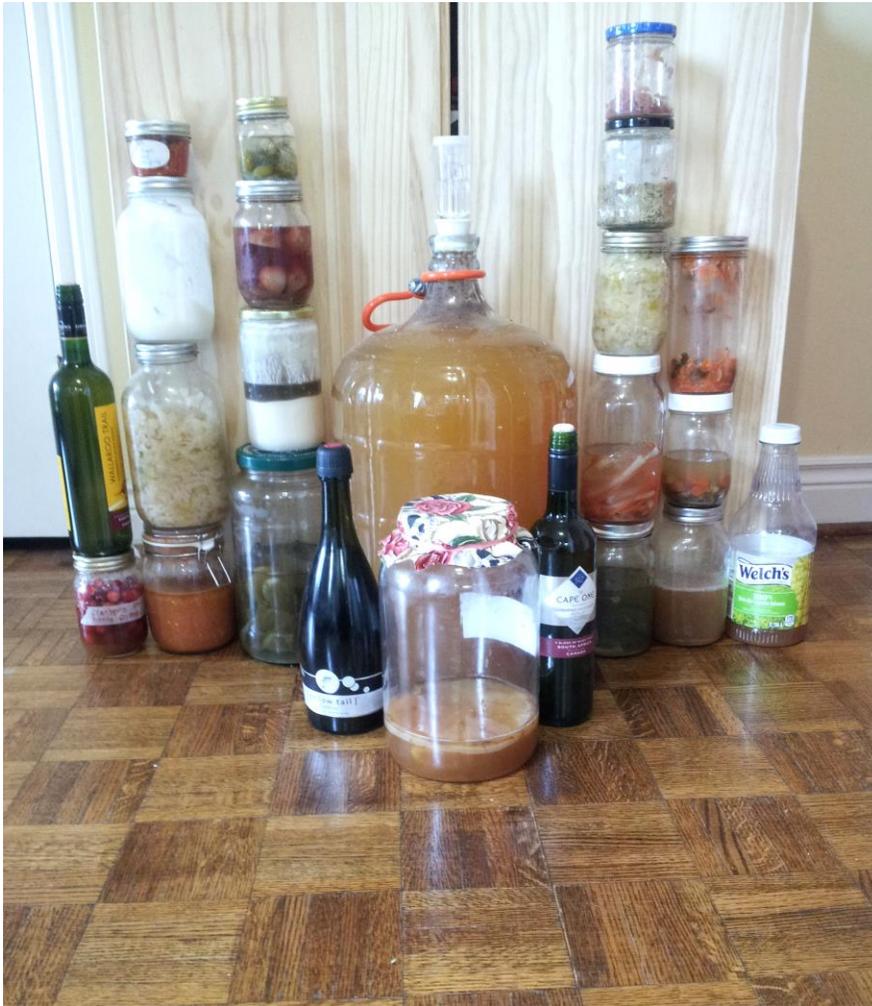
something to help you stay healthy, but it's not like something that is going to be a cure-all. Like the good bacteria can have a good effect on your gut, but it's not necessarily [that by] eating fermented foods, if you get the flu it's not going to cure it." I still had a sense that throughout the sauerkraut workshop because of D's strong presence and message that the participants might have received a confusing idea of what fermented foods could *do* health-wise.

## **Conclusion**

In both fermentation workshops, I was looking to not only teach people how to make fermented foods, but also to see if partaking in this hands-on activity might change their relationship to, and ideas about bacteria. I also used workshops to see if embodied knowledge was something I could help teach. It turned out that fermentation workshops have the possibility of changing participants' attitudes around bacteria, and embodied knowledge cannot be taught in the traditional sense, but it is a process, that another person can help guide you through. To me, the messiness of building these companion species relationships speaks to the impurity of the process.

In the sauerkraut workshop, participants tended to be low-income. The purity politics of sauerkraut do not just involve the cabbage and the bacteria. Some recipes for sauerkraut advise you to use expensive salts in order to make the a better, more mineral-rich ferment, I do not have the money for fancy salt and have not encouraged the necessity of fancy salts in my workshops. I have also heard other people adamantly discuss how they would only ever ferment organic vegetables. In both the sauerkraut and the kimchi workshops we discussed whether or not to ferment in plastic, and while I generally advise against it if possible; I think it

is better to push against a politics of purity and ferment in plastic, if that is what is available to you. I do not want to encourage an attitude that fermentation only works if you use the highest cost ingredients and supplies. Part of pushing against class politics in fermentation workshops, is meeting workshop participants where they are at.



A collection of all the homemade ferments I could find in my fridge.

### **Conclusion**

To me, fermented foods, and particularly the making of fermented foods, is against purity in that we are working with microbes to create a food product that is only partially under human control. Research done on the domestication of microbes, focusing on wild fermented foods

like kimchi shows that although there is commonality in the patterns of bacterial succession between different kimchis, the microbial makeup can vary greatly between different batches (Gibbons and Rinker, 2015, 5). Kimchi and other fermented vegetables like sauerkraut resist our control; resist notions of purity. The fact that when we do try to assert our control through the use of starter cultures (that skip over stages of bacterial succession) the ferments tend to have less complex flavours and less appealing textures, speaks to fermented foods as always entangled and *not* pure. Like the matsutake mushrooms that Anna Tsing writes about in *The Mushroom at the End of the World*, kimchi and sauerkraut are fermented foods "that cannot live without the transformative relations with other species" (Tsing, 2015, 38).

As I was just describing with the differences between batches of kimchi, fermentation is a means of creating companion species relationships because it moves us away from the sense of control that purity necessitates. In this paper I have demonstrated that throughout the history of fermentation, fermented foods have always been embedded in human power relations. Fermentation is related to the development of human civilization because it allowed foods to be preserved longer, as well as making them more nutritious. Both of these things have aided human settlements. While over time our control over microbes in fermented foods has increased, this has often coincided with processes of industrialization that have brought more inequality and oppression. When yogurt-making and beer-making industrialized and moved from women's work to men's work, women lost income, and control over their livelihoods decreased. Similarly, the industrialization of bread-making concentrated the power of bakery owners in fewer and fewer hands.

Louis Pasteur's microbial revolution changed our understanding of what causes diseases, and our understanding of a world previously unseen and unknown; a world of microbes. Pasteur's research laid the groundwork for the later development of antibiotics. As Paxson and Helmreich discuss, today we are able to have a different view of microbes than in Pasteur's time, which is more positive and more in line with companion-species-ship. This is because we have cured and eliminated some of the most deadly bacterial infections and viruses.

Connecting the first and second chapters, I wondered in my workshops whether a post-Pasteurian ethic (of letting go of control over microbes) could be developed through the fermentation workshops I facilitated. While the discussion from these workshops was not conclusive, there were some people who expressed that they had changed their ideas of how they viewed microbes; this is something I would like to continue to investigate in future workshops. One thing these workshops demonstrated is that while embodied knowledge cannot be taught in the traditional sense, it can be discussed and encouraged, along with hands-on experiences. It seems that the time scales that embodied fermentation processes tend to take place on, can contribute to a process of making kin with microbes. Teaching about microbes to people from diverse groups can mean stepping out my comfort zone. It also means letting go of control over the workshops.

Fermentation is a fertile ground (a bubbling crock) for politics of impurity because of its relationality. Through fermentation, I want to continue building these relationships, with diverse groups of microbes, and people.

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## **Appendix I: Workshop Discussion Questions**

### **Kindred Cultures Research Study: Post Fermentation Workshop Discussion Questions**

What did you learn about fermentation?

Has your view of bacteria changed?

Do you think you will ferment at your house?

How did you feel about the open-endedness of the recipe? Is this different than how you usually cook/ prepare foods?

How do you feel about judging by your senses to see if a ferment is salty enough?

How do you feel about judging by your senses to see if a ferment is acidic enough?

How do you feel about judging by your senses to see if a ferment is done/ ready (to go in cold storage/eat)?

(If further prompting is needed- to these things make you nervous or excited? Do you wish I had just given you a more exact amount of time and more 'scientific' instructions?)

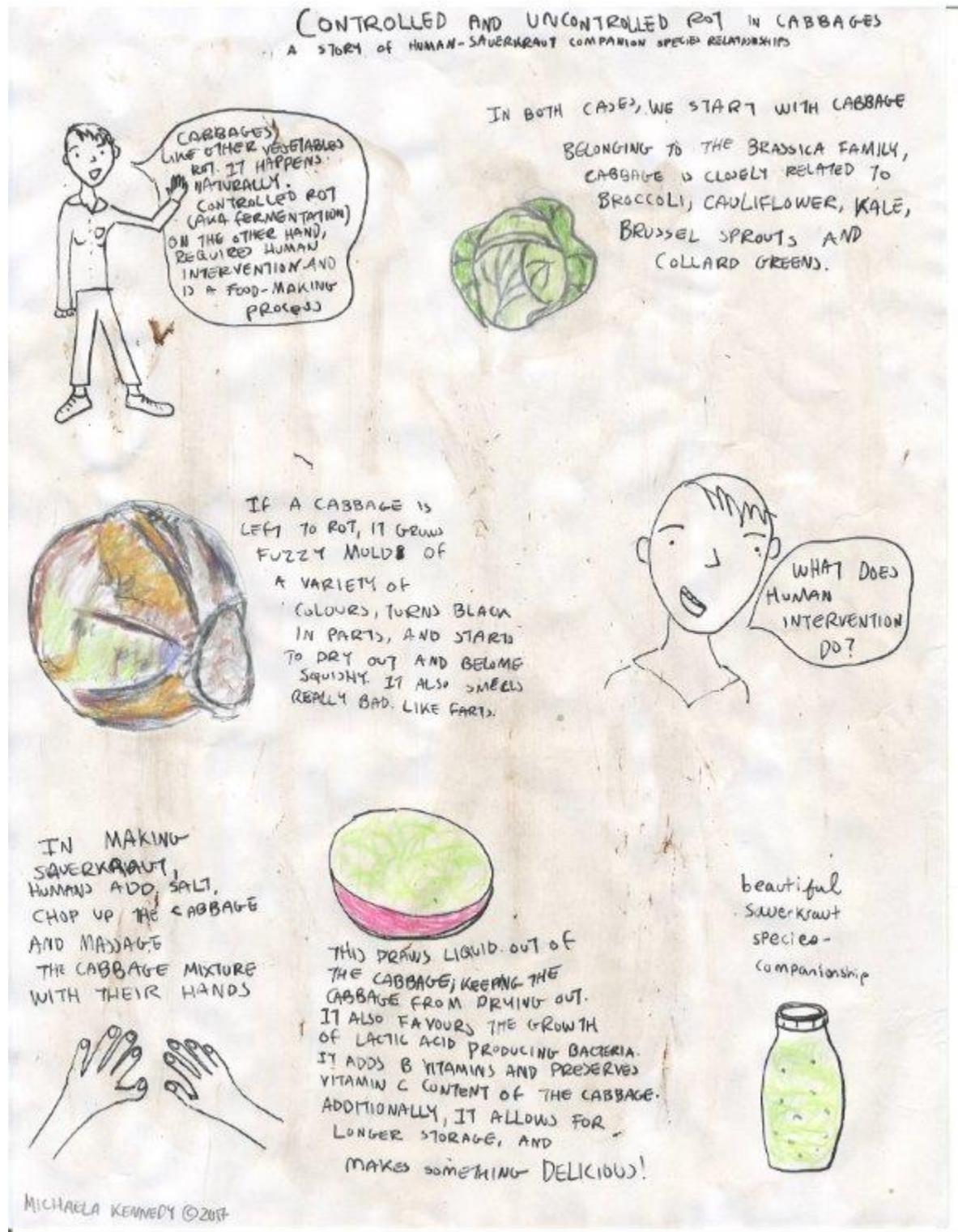
## Appendix II: Sauerkraut Recipe

1. **Chop/ grate the vegetables. How fine or thick you grate/ chop is up to you.** Different textures can be nice and add variety.
2. **Pound, massage and knead your cabbage mixture adding salt as you go.** A good ratio is around two teaspoons per pound of cabbage (roughly four heaping cups chopped cabbage). Salt helps to draw moisture out of the vegetables, as well as slowing down the fermentation process. It's common for people to add less salt in winter and more in summer for this reason.
3. ***How do you know when your cabbage mixture is ready?*** You'll know, when it is sitting in its own liquid
4. **Next put your cabbage mixture into a fermentation vessel.** Your vessel could be a jar or a crock (non-metal). It's important when you're filling your fermentation vessel to really cram the veggies in there, such that the liquid rises above the veggies. This brine on top helps to prevent mold growing.
5. **A weight on top can help you veggies stay submerged beneath the brine.** An easy weight is a Ziploc bag filled with salt water.
6. **Ferment for around two to three weeks.** The fermentation process usually takes longer in the winter and shorter in the summer. You can taste it as you go. Many people like it after two or three weeks, but there is no wrong answer. Once it's done to your liking, you can put it in fridge, or a cellar, or other similar environment. This cold environment will significantly slow down the fermentation; though it will not stop it.

### Appendix III: Kimchi Recipe

1. Measure out ingredients water and rice flour into your saucepan. You will want one recipe of paste for every 1 ½ to 2 litres of vegetable mixture. Cook on stove at low heat, stirring frequently. Once you get to the consistency of thin rice gruel, you add the red pepper powder. Next garlic and ginger gets stirred in. Now is the time to add some extra hot pepper if you like things more spicy. Let it cool.
2. Chop/ grate the vegetables. How fine or thick you grate/ chop is up to you. Different textures add variety. Grate ginger and mince garlic, but keep them aside for later.
3. Pound, massage and kneed your cabbage mixture adding salt as you go. Salt should be to taste. Salt helps to draw moisture out of the vegetables, as well as slowing down the fermentation process. It's common for people to add less salt in winter and more in summer for this reason. *How do you know when your cabbage mixture is ready?* You'll know when it is sitting in its own liquid.
4. The paste gets poured into the bowl(s) of pounded veggies. Stir well, so everything gets coated.
5. Next put your cabbage mixture into a fermentation vessel. Your vessel could be a jar, a crock, or a barrel (some people ferment in plastic, but I prefer not to). In this workshop, we've used jars. It's important when you're filling your fermentation vessel to really cram the veggies in there, such that the liquid rises above the veggies. This brine on top helps to prevent mold growing (not to worry though, this isn't a dangerous mold and the top inch or so can be scraped off if you do get some mold growth).
6. A weight on top can help you veggies stay submerged beneath the brine.
7. Ferment for between a few days and a few months (some people even go for a year). It's up to you. The fermentation process usually takes longer in the winter and shorter in the summer. You can taste it as you go. Many people like it after two or three weeks, but there is no wrong answer. Once it's done to your liking, you can put it in fridge, or a cellar, or other similar environment. This cold environment will significantly slow down the fermentation; though it will not stop it.

Appendix IV: Comic about microbial rot

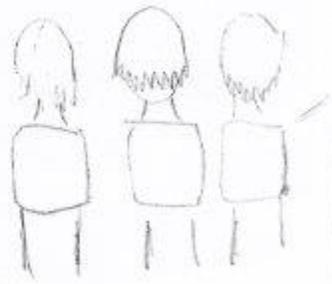


Appendix V: Horizontal gene transfer comic

# Horizontal Gene Transfer Activity



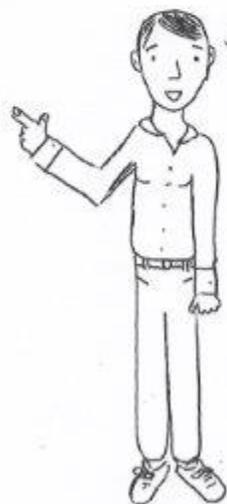
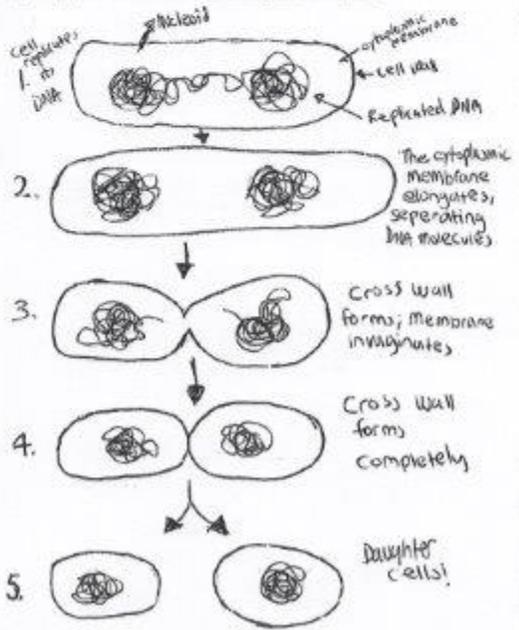
So one of the activities we're doing as part of this presentation is an exercise where we will demonstrate a simplified version of what horizontal gene transfer, or HGT, looks like.



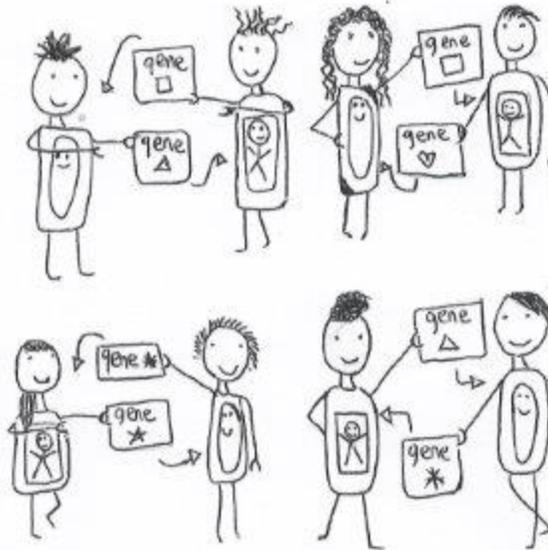
What is horizontal gene transfer you might ask, and how is it different than reproduction in bacteria?



## Reproduction in Bacteria!



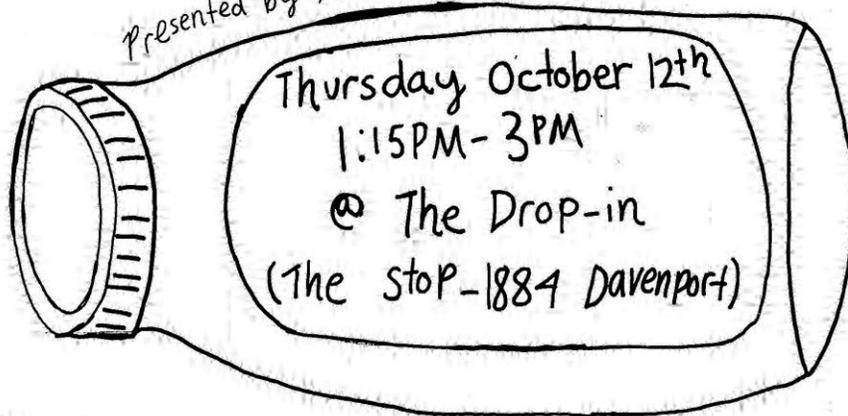
So this is what reproduction in bacteria looks like. Horizontal gene transfer on the other hand is "the process of swapping genetic material between neighbouring 'contemporary' bacteria". In other words, it is a swap that takes place between bacteria that are similar to each other.



# FERMENTATION WORKSHOP

Learn to  
make your  
own  
Sauerkraut!

Presented by Michaela Kennedy



- Bring home a jar of sauerkraut
- No experience preferred :)
- Hands-on workshop followed by discussion.



Michaela Kennedy is a Masters student at York University. She is a seasoned fermenter and fermentation workshop facilitator.

