The Science of Pickling

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Before the modern era of solid chemicals and preservatives, various processes were used throughout history to accomplish longer-lived foods. Examples include salting or dehydrating meats, combining fruits and sugar to make jams, and making dairy into cheese. For vegetables, the process of using salts, sugars, and vinegar for preservation is called “pickling.” The most enigmatic example of pickling we see are pickled cucumbers, which, in the English-speaking world, are colloquially called “pickles.” In creating a dish that would showcase the scientific concepts of food, the following research focuses on the process of making our own pickles.

The history of pickles is nearly as long as civilization itself. According to PBS columnist and food historian Tori Avery, the term originated from either the Dutch word “pekel” or the German “pókel.” Despite the Germanic roots of the word, pickles are far older than the Dutch or German languages. It is speculated that the first pickles can be traced all the way back to approximately 2030 BC (Avey 2014). Eventually, Kosher dill pickles became a staple among Jewish communities living in Eastern Europe, which formerly had a very bland diet due to the harsh climate and lack of agricultural variety. In addition, sailors and other military groupings adopted pickles as a staple food due to their shelf-stable quality and ability to be shipped across great distances.

While cucumbers remain the most popular pickled vegetables, countless other fruits and vegetables are widely consumed across many distinct cultures. Pickled onions, cauliflower, cabbage, and even pickled meats and cheeses can be found in the cuisine of countless people. In addition to these varieties of foods that have been pickled, there are also great varieties in the methods by which pickles can be created. Kosher dill pickles are the result of a method known as “lacto-fermentation” (Avey 2014). Lacto-fermentation is also the process used to create the German “sauerkraut,” a fermented cabbage that is eaten both on its own and used as a condiment.

We chose to create several batches of pickles, which all used varying types of vinegar for the acidic component. For the basic recipe, we took inspiration and guidance from Jeanine Donofrio’s “Dill Pickles Recipe,” first posted to the cooking website “Love and Lemons” in 2018 (Donofrio). Our recipe starts by cutting cucumbers lengthwise into quarters to make pickle spears. Both spears and chips are common cuts for pickling cucumbers, as the exposed inside of the vegetable helps the pickling solution penetrate the cucumbers. Next, divide the cucumbers into four 8-ounce glass jars or, alternatively, two 16-ounce glass jars. These various batch sizes have little bearing on the final product but are instead a matter of equipment and personal preference.

After jarring, the recipe calls for the creation of a pickling solution, which will transform our cucumbers into pickles. The pickle recipe consists of between twelve and fourteen Persian cucumbers, four garlic cloves, two teaspoons of mustard seeds, two teaspoons of peppercorns, a few fresh dill sprigs per jar, two cups of water, two cups of the desired vinegar, a quarter cup of cane sugar, and two tablespoons of sea salt (Donofrio 2018). Donofrio calls for heating water, vinegar, sugar, and salt in a medium saucepan over medium heat until the sugar and salt dissolve (2018). We completed the recipe with four different kinds of vinegar to see the difference in results. Our four batches of pickles were finished in white vinegar, apple cider vinegar, red wine vinegar, and balsamic vinegar. Each of the four jars was separated to contain only one kind of vinegar. The pickles must sit in the solution for at least two days before consumption, but the recipe's author

recommends five or six days for maximum flavor development. Then, they can be stored in the fridge for several weeks.

While flavor preference is subjective, we took several detailed notes on the results of each kind of pickle. The “white vinegar pickle” was everything expected of a traditional dill pickle. It took on the flavors present in the pickling solution to create a very average, yet still delicious, dill pickle. Our second pickle, the “balsamic pickle,” sat in a similar pickling solution, but the white vinegar was replaced with balsamic vinegar. The color of the pickles took on a blackened color and did not effectively pickle. Instead of pickling, they took on a slightly sweet taste due to the flavors present in the balsamic. While not a true pickle, the cucumbers did not become inedible or acrid. For our third pickle, we chose to do a “red wine pickle” which used red wine vinegar. These pickles were similar to the white vinegar pickles in both taste and texture.

They did differ, however, in that they took on a slightly sweeter taste and a reddish hue from the red wine vinegar. Finally, we experimented with our last pickle by using apple cider vinegar to create our “apple cider pickle.” This pickle was quite distinct from the others, with it having taken on a yellow hue from the vinegar as well as an extreme and unpleasant sour taste. The acrid flavor and dissimilarity to the other pickles made the apple cider pickle somewhat of a failure compared to our other batches.

Considering our understanding of the history behind pickling, its importance in such a vast number of cultures, and the results of our culinary experiment, it is crucial to analyze the science behind pickling. First, it is critical to understand how the pickling process transforms the raw ingredients into something new and shelf-stable (Bonem 2017). According to food scientists, the process of lacto-fermentation, which is the process used in making dill pickles, relies on using acids, salts, and naturally occurring lactic acid to start the fermentation process (Sawada et al. 2021). The pickling process results in the development of many beneficial microbes that were not present in the base ingredients. In addition, the pH of the pickling solution begins with a moderate level of acidity. This is due to the presence of vinegar, among several other ingredients. However, this is not the case

throughout the entire pickling process. Lactic acid produced during the fermentation process raises the acidity and contributes to the safe preservation of pickled vegetables. The acidity of the pickles reduces the presence of microorganisms that would cause quicker rot and decay (Sawada et al. 2021)

On the topic of texture, the high salt content of the pickling liquid helps to keep the vegetables crunchy. This is something seen as desirable in pickles, and the presence of specific kinds of salt can change the results of the pickle texture (Bonem 2017). The salt content in the pickling liquid also draws out moisture from the pickles initially, which contributes to the softened flesh of the vegetable and allows the brine's flavor to penetrate the pickles (Sawada et al. 2021). According to many food scholars, the unique properties of cruciferous vegetables, such as cucumbers, lend very well to pickling. The behavior of glucosinolates takes on a unique flavor and creates new compounds when they are damaged during the pickling process (Suzuki et al. 2006). In addition, leading experts on pickling in the culinary field have recommendations as to which kind of vinegar is best for the pickling process. Despite our personal results, the experts often recommend either white distilled vinegar or apple cider vinegar (Great Lakes Pickling Company). Most negative microbes that could turn the would-be pickled vegetables rotten and acrid will die at a pH of 4.6 or lower, so experts recommend a solution that errs on the side of caution with a pH of 4.5 or even a bit lower (Ward).

Pickles have long been a staple of human diets since the earliest glimpse of civilization. This is for a good reason, as pickling has been a critical way to produce shelf-stable food with an exciting flavor among bland diets. Further, the pickling process can neutralize harmful microbes, which may turn food acrid and rotten. The pickling of vegetables can create unique and long-lived foods. However, the pickling of cruciferous vegetables like cucumbers remains the most common target of pickling. The impressive science and history of pickling solidify it as a staple of the human diet that is likely to be around for a long time.

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