A taste of Place

The French are given credit for being the first to recognize the importance of the taste of place, or *terroir*. They have long identified the place of growing food with the qualities of the food. For this reason French wines are named for where the grapes are grown rather than the variety of grape, as is done in America. In addition to wine it is now widely recognized that the quality and flavor characteristics of olive oil, cheese, and honey are related to where they are grown. In parts of France certain wines and other agricultural products are labeled *Appellation d'Origine Contrôlée,* while in Italy they are labeled Denominazione di Origine Controllata, to indicate they are produced in specific regions of the countries. In the United States we have Vidalia onions, which may be grown only in the southeastern counties of Georgia according to the Vidalia Onion Act of 1986. For an excellent review of the role of terroir in the quality of food read "*The Taste of Place"* by Amy B. Trubeck (2008).

Cooking with local ingredients is becoming a huge trend in America. Most chefs believe that local ingredients are not only fresher, but that they "taste better". But is there any science to support this? Yes! There are now many examples in the scientific literature of the impact of growing conditions and the environment on the flavor and texture of food. Perhaps best known are the alliums, which include onion, garlic, leeks, scallions, shallots, chives, and even ramps. The alliums develop their characteristic flavor and pungency only when their cells are damaged and an enzyme called *alliinase* is released and comes in contact with sulfur-containing compounds called S-alk(en)yl cysteine sulfoxides (ACSO). That's why a whole head of garlic or an onion blub have no odor. The more that onion and garlic are chopped the more intense their flavor and pungency. The ACSO compounds are derived from the natural amino acid called cysteine. For a fascinating account of the chemistry of alliums read "*Garlic and Other Alliums: The Lore and the Science*", by Eric Block (2010), who has spent his entire academic career investigating the chemistry of alliums.

Not surprisingly, research studies have shown that the intensity of flavor and pungency of the alliums is related to the sulfur content of the soil (see J. Amer. Hort. Sci. 1995; 120(6): 1075-1081), which is referred to as the *sulfur fertility* of the soil. Sulfur exists in the soil in the form of "sulfate salts", which are absorbed by the plants and converted into the amino acid cysteine, and a few other sulfur-containing amino acids. Higher levels of sulfate in the soil are correlated with more flavor and pungency. Milder, sweeter onions like the Vidalia onion are grown in soils with low levels of sulfate (HortTechnology 2002; 12(2): 196-202). Another class of vegetables, the cruciferous vegetables, produce their characteristic flavor and pungency through chemistry that is similar to the alliums. But in this case another enzyme called *myrosinase* is liberated when the cells are damaged. Myrosinase converts a different group of sulfur-containing compounds called *glucosinolates* into compounds called *isothiocyanates* that are responsible for the flavor and pungency of cruciferous vegetables.

There are about 36 different cruciferous vegetables commonly consumed around the world. In America the most common are cabbage, kale, Brussels sprouts, broccoli, and broccoli rabe, cauliflower, mustard greens, collard greens, turnip, bok choy, swiss chard, radish, and arugula. All of these are tasteless until chopped or sliced. More cell damage creates more flavor. Blanching cruciferous vegetables inactivates the myrosinase enzyme resulting in milder, less bitter flavor. Like the alliums, research has shown that the sulfur fertility of the soil correlates with the flavor and pungency of cruciferous vegetables (see J. Agric. Food Chem. 2003; 51:5319-5325, and Plant Biol. 2007; 9: 573-581).

What really got me thinking more about the validity of the taste of place was a blind taste test done with cooked dry cannellini beans at America's Test Kitchen in 2013. Five different sources of beans were tasted plain, in a dip, and in a soup. All of the beans were tasted blind six times by a panel of 21 tasters each time. The dry beans were also sent to a laboratory to test for the level of calcium in the beans. Calcium in beans is mostly associated with the pectin that holds the cells together as well as strengthens the cell walls. It was anticipated that more calcium would result in less "blow out" (bursting of the outer shell) of the beans and a better interior texture. The results were astounding! The ranking of the beans correlated perfectly with the calcium content, with the beans containing the most calcium ranking the highest. There were even two brands of beans that contained essentially the same amount of calcium that tied in the taste ranking!

Cooked Dried Cannellini Beans

Rank	Brand	Calcium (mg/100g)
1	A	362
2	B	204
Tie	C	176
Tie	D	175
5	E	168

As you might have guessed by now, research studies have shown that the level of calcium in beans is related to both the genotype and calcium content of the soil (see HortScience 1999; 34(5): 932-934, and J. Amer. Soc. Hort. Sci. 1999; 124(3): 273-276). So again, where the beans are grown matters!

Outside of the world of plant foods I should mention the interesting exploration of *microbial terroir* by David Chang, chef/owner of the Momofuku restaurants. Chef Chang is experimenting with local microorganisms to impart different regional flavors in fermented foods (see Internat. J. Gastro. Food Sci. 2012; 1: 64-69).

Benjamin Wolfe, a collaborator with David Chang working at Harvard University, has evaluated the different bacteria, yeast, and mold that colonize regionally made salami and found some fascinating results (see Lucky Peach, issue 4, summer 2012, pages 103-107, and photo below courtesy of Ben Wolfe). According to Ben, salami colonized with different microorganisms have distinctly different flavors (notice the different yeasts and molds growing on the surface of the salami). Microbial Terroir at work!

Portland Virginia Oakland Utah Berkeley

Finally is the question of the taste of place of other foods. It is easy to see why the flavor of alliums and cruciferous vegetables are closely linked to where they are grown. They owe their flavor to specific enzymatic reactions that occur with a small group of sulfur-containing compounds derived from the amino acid cysteine. So the sulfur content of the soil is a very important factor in the intensity of flavor of these plant foods. But many other vegetables have more complex sources of flavor. Potatoes are an example. Cooked potatoes (boiled, baked, or steamed) owe their flavor to many different reactions that occur during cooking, including reactions of fats and sugars and amino acids, the formation of sulfur-containing compounds, and the Maillard-Hodge reaction that forms potent aroma compounds called pyrazines. Research has shown that the flavor of cooked potatoes is determined by both genotype and environmental conditions (see Amer. J. Potato Res. 2008; 85: 455-465). But because of the complexity of the many flavor-forming reactions there is no single environmental factor, such as the sulfur content of the soil, that can be correlated with cooked potato flavor. Not all foods can be linked to a taste of place.