Flavorings

The flavor of food is incredibly important—arguably the single most important variable in your enjoyment of a meal. Flavors change our behavior: the smell of freshly baked bread draws us into the bakery, the aroma of fresh herbs and toasted spices in a meal makes us salivate, and the memory of what something tasted like brings us back for another purchase. The loss of smell—*anosmia*—is considered one of the most severe sensory losses. Think about the last time you had a cold with a plugged-up nose—food becomes so much less appealing without flavor!

Being able to add flavors to foods opens up new possibilities. Industry relies on flavorings as part of mass manufacturing. An acquaintance of mine who used to work at Campbell Soup Company pointed out that meats lose most of their flavor when steam-cooked (which is how chicken for chicken noodle soup is cooked at scale), so flavorings have to be added back in. Coloring extracts are added too, even if their source is traditional ingredients such as turmeric (yellow), paprika (red), or caramel (brown). Flavor is absolutely critical to industry, which knows very, very well that a quickly tapering-off flavor causes you to reach for a second bite, and an appealing flavor triggers a repurchase the next time you're at the store.

Creating good aromas and flavors is so critical that there are several categories of *E* numbers just for compounds that change taste. One category, flavor enhancers (E600s), alters the way foods taste. ("Flavor enhancers" is something of a misnomer; "taste enhancers" would be better.) Most of the compounds in this range are glutamic acid salts like MSG (E621), but there are also those that make foods taste sweeter, like the amino acid glycine (E640). Speaking of sweet: artificial sweeteners (E900s) get their own *E* number category that includes compounds such as sucralose (E955) and stevia's active chemical (E960). Unless you have some rather impressive lab equipment in your kitchen, making *E*-numbered compounds isn't exactly a home project. (Time to whip up some fresh guanylic acid!?) Keep in mind that there are plenty of traditional ways to boost tastes, such as adding ingredients high in glutamic acids (see page 76), or simply a pinch of salt.

But what about actual flavorings? As I mentioned earlier, the *E* number list isn't an exhaustive source of food additives. Vanillin doesn't show up, even though it's a single molecule with a well-defined structure that's often added to food. Home cooks use vanilla extract, though, not vanillin powder, and that's where we can get into some fun, creative experiments: flavor extracts.

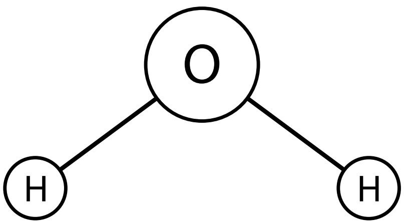
Flavoring extracts are used to add new aromas to food or amplify existing ones. Their functional purpose is to carry volatile compounds—ones that easily evaporate—to tickle the sensory apparatus of the nose. Luckily, many volatile compounds in food are also easily dissolved by solvents. Solvents, as we'll see, are the key to creating extracts that can carry flavors.

In cooking, we use three primary solvents: water, lipids, and alcohol. Each works on different types of compounds, so matching the chemistry of the solvent to the chemistry of the volatile compound is the key to making good extracts. The same chemical principle that allows water to dissolve compounds also applies to lipids and ethanol, so which solvent to use depends on the structure of the compounds being dissolved.

But *how* does a solvent work? What happens when one molecule bumps into another molecule? Will they form a bond (called an *intermolecular bond*—one that happens between different molecules) or repel each other? It depends on a number of forces that stem from differences in the electrical charges and charge distributions of the two molecules. Of the four types of bonds defined in chemistry, two are important in flavoring extracts: polar and nonpolar.

A molecule that has an uneven electrical field around it or that has an uneven arrangement of electrons is *polar*. The simplest arrangement, where two sides of a molecule have opposite electrical charges, is called a *dipole*. Water is polar because the two hydrogen atoms attach themselves to the oxygen atom such that the molecule as a whole has a negatively charged side—it's a dipole.

When two polar molecules bump into each other, a strong bond forms between a positive region on the first molecule and a negative region on the second molecule, just like when two magnets are lined up. On the atomic level, the area of the first molecule that has a positive charge is balancing out the area of the second molecule that has a negative charge.



A water molecule is polar because of an asymmetric distributions of charges. This happens because oxygen is more electronegative than hydrogen and the bent shape of the water molecule. This shape gives it a positive charge on one side and a negative charge on the opposite side, making it polar.

A molecule that has a symmetric shape or atoms with only a small difference in electronegativity has a symmetric charge distribution on all sides—this is called *nonpolar*. Oil is nonpolar because it is made of mostly carbon and hydrogen, two molecules which have small differences in electronegativity.

In most cases, when a polar molecule bumps into a nonpolar molecule, the polar molecule is unlikely to find an electron to balance out its electrical field. It's like trying to stick a magnet to a piece of wood: the magnet and wood aren't actively repelled by each other, but they're also not actually attracted. A polar and nonpolar molecule won't form a bond and end up drifting off elsewhere, continuing to bounce around into other molecules.

This is why oil and water don't normally mix, but sugar and water easily do. The water molecules are polar and form strong intermolecular bonds with other polar molecules—they're able to balance out each other's electrical charges. At an atomic level, the oil doesn't provide a sufficiently strong bonding opportunity for the negatively charged side of the water molecule. Water and sugar (sucrose), however, get along fine. Sucrose is also polar, so the electrical fields of the two molecules are able to line up to some degree.

The strength of the intermolecular bond depends on how well the solvent and solute compounds line up, which is why some things dissolve together well while others only dissolve together to a certain point. A number of organic compounds that provide aromas in food are readily dissolved in ethanol but not in water or fats.

You will invariably encounter dishes where alcohol is used for its chemical properties, either as a medium to carry flavors or as a tool for making flavors in the food available in sufficient quantity for your olfactory system to notice. Alcohol is often added to sauces or stews to aid in releasing aromatic compounds "locked up" in the ingredients. Try adding red wine to a tomato sauce!

Toasting spices in oil—called *blooming*—causes the oil to capture flavor volatiles from the spices that evaporate as the seeds are heated.

Does Alcohol "Burn Off" in Cooking?

No, not entirely. Even though the boiling point of pure ethanol (C_2H_5OH) is lower than that of water at atmospheric pressure (173°F / 78°C), the intermolecular bonding between ethanol, water, and other compounds in the food is strong enough that its boiling point varies based on the concentration of ethanol in the food and how strongly it bonds with other compounds.

The amount of alcohol remaining after cooking depends on the cooking methods, according to a paper published by researchers at the University of Idaho. They happen to be at 2,500 feet / 762 meters above sea level, meaning the vapor pressure would be lower than at sea level, just in case you need an excuse…

Cooking method	% alcohol remaining
Alcohol added to boiling liquid and removed from heat	85%
Alcohol flamed	75%
No heat, stored overnight	70%
Baked, 25 minutes, alcohol not stirred into mixture	45%
Baked/simmered, alcohol stirred into mixture…	
…for 15 minutes	40%
…for 30 minutes	35%
…for 1 hour	25%
…for 2 hours	10%

Vanilla Extract

Vanilla extract is a classic example of using alcohol as a solvent. Very few plant-based compounds are soluble in water—they'd wash away in nature. Hot water will work in some cases—how else would mint or chamomile tea work?—but when making extracts, you'll need to use either ethanol or fat, depending upon the molecule you're trying to extract. (Most aromas are based on multiple compounds, a detail I'm skipping here.)

Vanilla extract is easy to make. Ethanol from a spirit such as vodka (80 proof will be about 40% ethanol) will dissolve some of the 200+ compounds in the vanilla bean responsible for vanilla aroma, including vanillin, which gives vanilla most of its hallmark flavor. (The different ratios of some of the more pronounced compounds are what cause differences between various cultivars of vanilla.)

Vanilla beans are still pricey. Buy them online, and for making vanilla extract, Grade B is just fine. (Grade B is what industry normally uses—who cares that the pods aren't as pretty when they're going to be chopped up?)

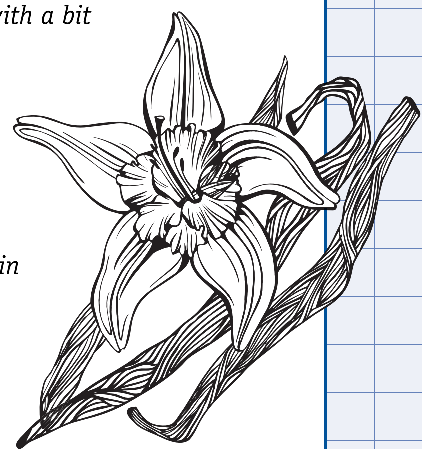
In a small glass jar with a tight-fitting lid, put:

1 vanilla bean (~5g), sliced open lengthwise and chopped into strips to fit jar
2 tablespoons (30 mL) vodka (use enough to cover the vanilla bean)
½ teaspoon (2g) sugar

Screw the lid on the jar or place plastic wrap over the jar's top and store it in a cool, dark place (e.g., a pantry). Give the extract at least several weeks to steep.

Notes

- *The vanilla bean can be left over from some other recipe. If you cook with vanilla frequently, consider keeping the jar of vanilla constantly topped off. Whenever you use a vanilla bean, add it to the jar, removing an old one when space requires it. And as you use the extract, occasionally top off the jar with a bit more liquid.*
- *Play with other variations: instead of vodka, which is used for its high ethanol content and general lack of flavor, you can use other spirits such as rum, brandy, or a blend of these. Or, instead of vanilla beans, try using star anise, cloves, or cinnamon sticks. Try varying both solvent and solute (e.g., Grand Marnier with orange peel in it).*



Infused Oils and Herbed Butters

Infused oils and herbed butters, like extracts used in cooking, can carry flavor from plants into your food. Unlike extracts, which have a harsh taste from the alcohol, infusions can be used as part of the finished dish. Salad dressed with a basil-infused oil? Salmon drizzled with rosemary-infused oil? Basil butter on bread? Next time you have extra herbs, try mixing them in with a fat.

Fats and oils are nonpolar molecules (see page 148), so given the chemistry rule of thumb that like dissolves like, *it's no surprise that they dissolve other polar molecules. Many odor compounds are bound up in plant oils—oregano has carvacrol in oil droplets on the leaf surface—but not all plant odor compounds are fat-soluble. I tried making sage-infused oil with only mild success; a search online showed that one of the primary odorants of sage, manool, is normally dissolved with alcohol. A quick test making an ethanol-based sage extract worked instantly, giving recognizable sage flavor. If you find an herb doesn't infuse well, use it for herbed butter. Unlike infused oils that have the plant matter strained out, herbed butters don't rely on the fat solubility of the odorants.*

Infused Oils

You can infuse oils using either a cold process or heat process. Cold processing is better for herbs; spices do better in heated oils, which will bloom them, changing their flavor.

1. In a small bowl, measure out about **1 cup (240 mL) of a high-quality, neutral oil such as grapeseed**, **sunflower**, or **canola oil**; for stronger-flavored herbs, a mild **olive oil** works well.
2. Infuse!
3. *For herb infusions, follow a cold process:* Add **2–4 tablespoons (10–20g) herbs such as rosemary**, **oregano**, or **basil, finely diced**. Optionally add **1–2 tablespoons (5–10g) parsley** to make the infused oil greener. Using either a traditional blender or an immersion blender, blend the oil and herbs for 30 seconds or so. This will speed up the rest period; otherwise, you'll need to let the mixture rest in the fridge for much longer.
4. *For spice infusions, follow a heat process:* Add spices to the oil; try using a single spice, like cardamom or cinnamon, or a mix. For a simple curry oil, use **2 tablespoons (12g) curry powder**, **1 tablespoon (6g) fresh ginger** (finely minced), and **½ teaspoon (1g) cayenne pepper** or **chili flakes**. Add the oil to a pan over medium heat and heat the mixture for a few minutes to bloom the spices. (You should be able to smell them!)

Infused Oils and Herbed Butters (continued)

5. Transfer the infused oil back into the small bowl and cover. Cold-processed oils should rest for a few hours or overnight in the fridge. Heat-based infusions can be used right away, but allow them to rest a few minutes to cool to room temperature.
6. For clearer infusions with fresh herbs, filter the mixture though a fine mesh strainer or a strainer lined with cheesecloth (after it's rested!). To avoid cloudiness, don't press down on the mixture; allow it to drip separate for a few minutes.

Herbed Butters

Herbed butters are easier than infused oils: they don't rely on the flavor compound dissolving because the plant matter itself remains as part of the final product. Use flavorful herbs; more tender herbs like chives, tarragon, and sage are fast and easy to work with.

In a small mixing bowl, let **½ cup (115g) butter** come up to room temperature. If your butter is unsalted, add **½ teaspoon (3g) salt**; optionally add **freshly ground pepper**. Add about **2–3 tablespoons (10–15g) herb leaves**, washed and diced, and with any stems removed (you don't want little twiggy things in your butter!). Using a fork, mash the herbs and any seasoning into the butter. Serve it with bread or use it as an ingredient—try spreading a thin layer on top of cooked fish or meats.

Notes

- *Infusing a food's odor compounds into oil or vinegar doesn't change the properties of the compound. If it's heat-sensitive in the ingredient, it's going to be heat-sensitive in the infused version. Pan-searing pork with sage butter works fine, but a basil-infused oil would suffer.*
- *Store fresh-herb-infused oils and herbed butters in the fridge and use them within a week. Oils and fats with non-acidic wet plant matter immersed in them create a perfect anaerobic breeding ground for botulism. While uncommon, it is fatal if given time to fester. If you want to make shelf-stable infused oils with "wet" ingredients, you will either need to properly pressure-can the jars or acidify the plant matter—see* http://cookingforgeeks.com/book/infusedoils/ *for details. Dried spices and dried herbs don't have enough moisture to support rapid microbial growth, so infusions like dried peppers in oil that are heat-processed can be used for up to 3 months, although the US FDA recommendations are to keep them refrigerated and use them within 3 weeks.*