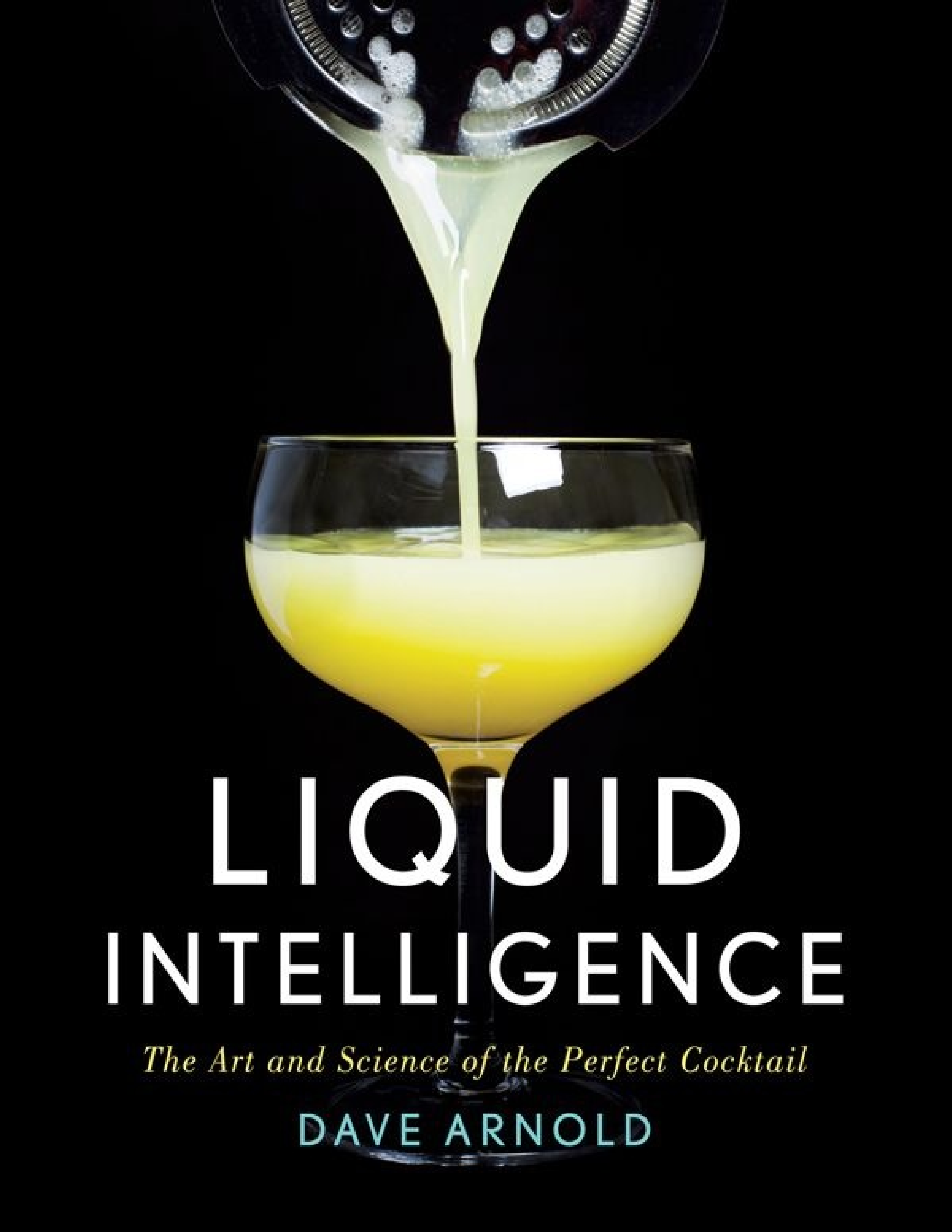
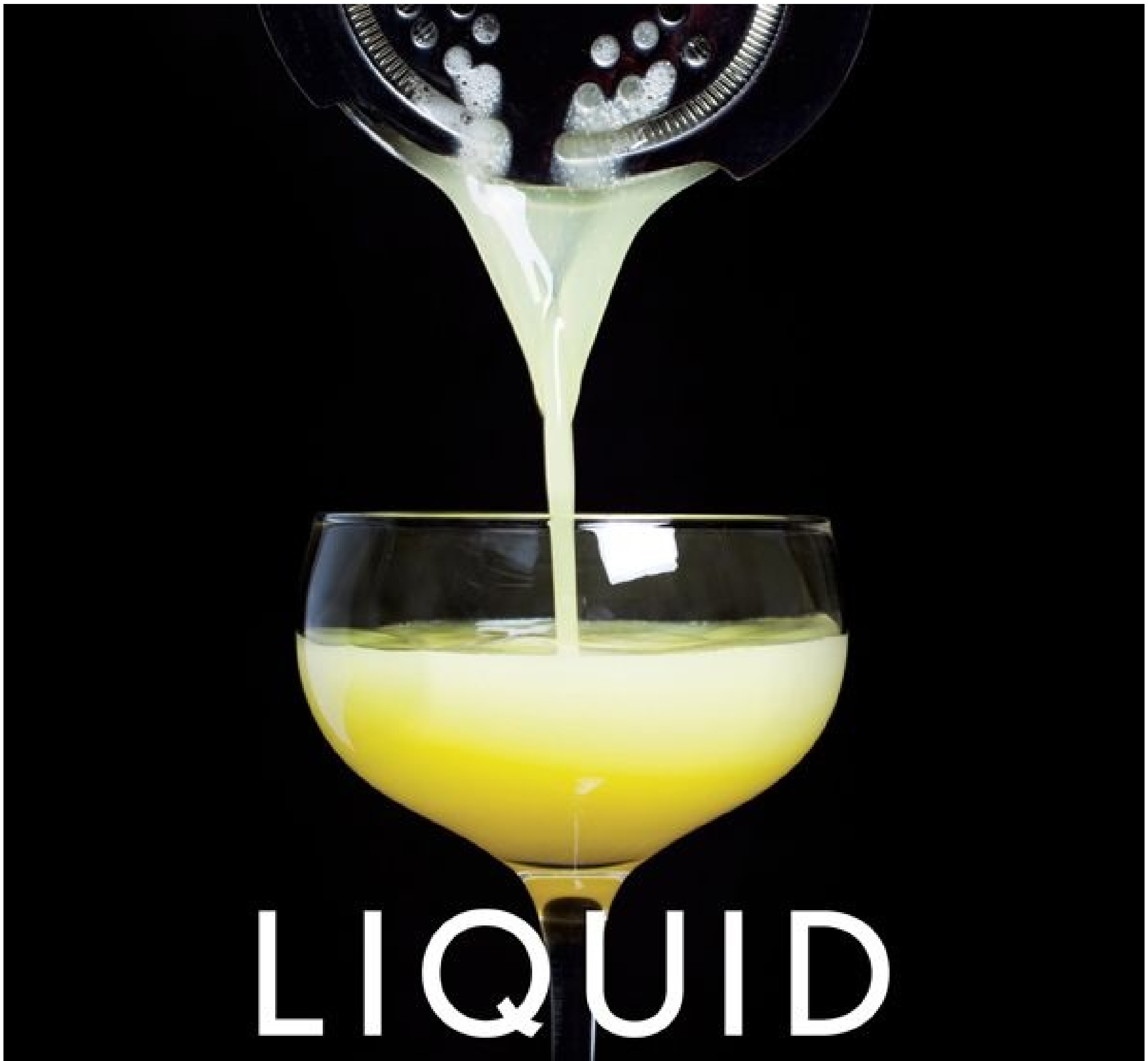


LIQUID INTELLIGENCE

The Art and Science of the Perfect Cocktail

DAVE ARNOLD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THE ART AND SCIENCE

OF THE PERFECT COCKTAIL

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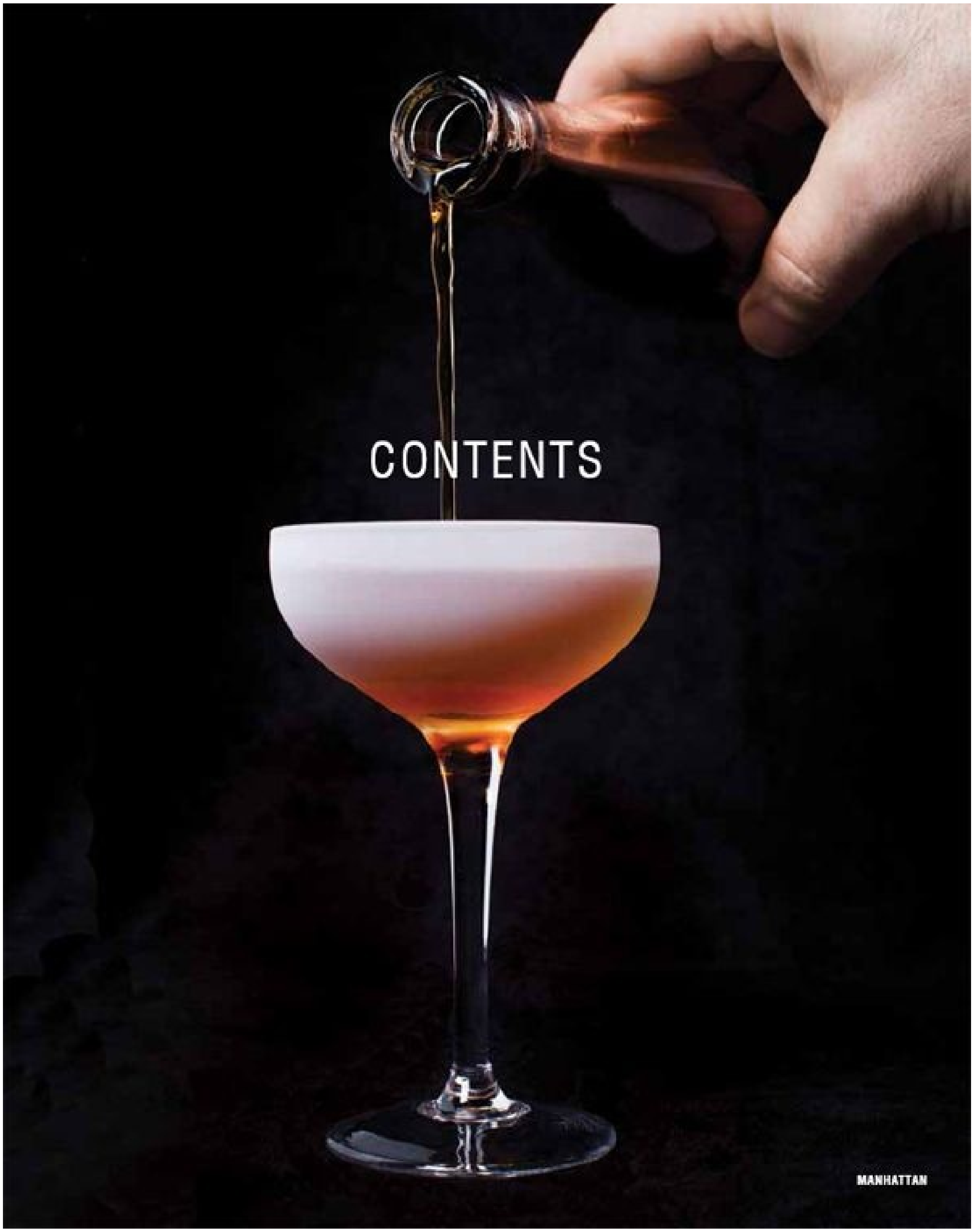
PHOTOGRAPHY BY TRAVIS HUGGETT

W. W. NORTON & COMPANY NEW YORK LONDON

FOR MY WIFE, JENNIFER, AND MY SONS, BOOKER AND DAX



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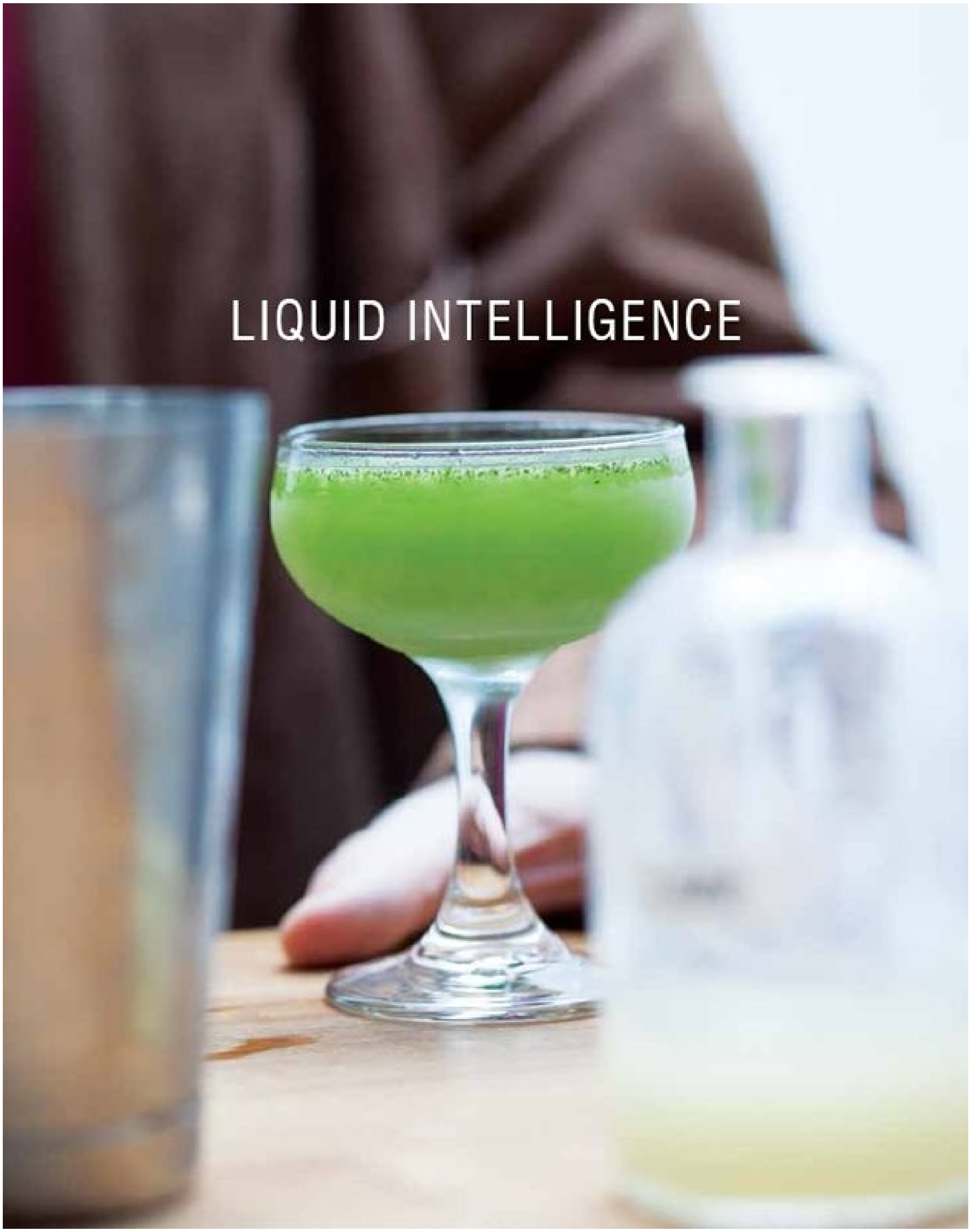

LIQUID INTELLIGENCE


CHARTRUTH

INTRODUCTION

Cocktails are problems in need of solutions. How can I achieve a particular taste, texture, or look? How can I make the drink in front of me better? Taking cocktails seriously, as with all worthy inquiries, puts you on a lifelong journey. The more you know, the more questions you raise. The better a practitioner you become, the more you see the faults in your technique. Perfection is the goal, but perfection is, mercifully, unattainable. I have spent seven years and thousands of dollars on the problem of the perfect gin and tonic; I still have work to do. How boring if I were finished—if I were satisfied. Learning, studying, practicing—and drinking with friends: that is what this book is about. The premise: no cocktail detail is uninteresting, none unworthy of study.

A little dose of science will do you good. **THINK LIKE A SCIENTIST AND YOU WILL MAKE BETTER DRINKS**. You don't need to be a scientist, or even understand much science, to use the scientific method to your advantage. Control variables, observe, and test your results; that's pretty much it. This book shows you how to make your drinks more consistent, how to make them consistently better, and how to develop delicious new recipes without taking random shots in the dark.

Sometimes on our journey, in hot pursuit of a particular flavor or idea, I use methods that are preposterous and equipment that is unattainable for most readers. You'll see what it means to run an idea into the ground. I also hope you'll be entertained. I don't expect most people to tackle these more involved drinks, but you'll get enough information to give them a go if you are willing and able. I'll hold nothing back and keep no secrets, which means there will be as many mishaps as successes (mistakes are often the origins of my best ideas). Last, I promise that there will be plenty of techniques, flavors, and drink ideas you can use, even if all you have is a set of cocktail shakers and some ice. I'm out to change the way you look at drinks, no matter what kind of drinks you make.

This is not a book on molecular mixology (a term I detest). The connotations of *molecular* are all bad: gimmicks for gimmicks' sake, drinks that don't taste very good, science gone wrong. My guidelines are simple:

- Use new techniques and technologies only when they make the drink taste better.
- Strive to make an amazing drink with fewer rather than more ingredients.
- Don't expect a guest to know how you made a drink in order to enjoy it.
- Gauge success by whether your guest orders another, not by whether he or she thinks the drink is "interesting."
- Build and follow your palate.

This book is divided into four parts. The first part deals with preliminaries—equipment and ingredients—that pave the way for the rest. The second part is a careful study of how classic cocktails work: the basics of shaker, mixing glass, ice, and liquor. The third part is an overview of newer techniques and ideas and how they relate to classic cocktails. The last part is a series of recipes, mini-journeys based on a particular idea. At the end you will find an annotated bibliography of cocktail books, science books, and cookbooks, plus journal articles that I find interesting and germane to our subject.

WHAT I AM THINKING ABOUT PRETTY MUCH ALL THE TIME

I approach cocktails like everything I care about in life: persistently and from the ground up. Often I perceive an irksome problem in an existing cocktail, or become entranced with an idea or flavor, and my journey begins. I ask myself what I want to achieve, and then I beat down every path to get there. I want to see what is possible and what I'm capable of. In the initial phases of working through a problem, I don't much care if what I'm doing is reasonable. I prefer to go to absurd lengths to gain minute increments of improvement. I am okay with spending a week preparing a drink that's only marginally better than the one that took me five minutes. I'm interested in the margins. That's where I learn about the drink, about myself, and about the world. Sounds grandiose, but I mean it.

I am not unhappy, but I am never satisfied. There's always a better way.

Constantly questioning yourself—especially your basic tenets and practices—makes you a better person behind the bar, in front of the stove, or in whatever field you choose. I love it when my dearly held beliefs are proved wrong. It means I'm alive and still learning.

I hate compromising, and I hate cutting corners, but sometimes I have to. You need to keep hating compromise at every turn while knowing how to compromise with minimum impact when necessary. Always be focused on the critical path to quality, from raw ingredients to the cup. I am often surprised by how much work someone will put into making ingredients for a drink, only to destroy all that work at the last moment. Remember, a drink can be ruined at any stage of its creation. Your responsibility for vigilance as a drink maker doesn't end until the drink is finished—and your responsibility as an alcoholic-drink maker doesn't end until the imbiber is safe and sound at home.

PART 1

PRELIMINARIES

Measurement, Units, Equipment

Having access to cool equipment has helped me develop ways of achieving good results *without* the equipment. In this section we'll look at the equipment I use at home and at my bar, Booker and Dax. Almost no one—not even well-heeled professional bartenders—will want or need all the equipment on this list. In the technique-based sections of the book I'll give you workarounds for the bigger-ticket and hard-to-find items as often as I can. At the end of this section you'll find shopping lists organized by budget and interest.

A note on measurement, before we launch into a discussion of tools.

HOW AND WHY YOU SHOULD MEASURE DRINKS

Drinks should be measured by volume. I am a big believer in cooking by weight, but I mix drinks by volume, and so should you. Pouring out small volumes is much faster than weighing a bunch of small ingredients. Furthermore, the densities of cocktail ingredients vary wildly, from about .94 grams per millileter for straight booze to 1.33 grams per millileter for maple syrup. For the bartender, the weight of the finished beverage isn't important, but the volume is. The volume determines how close the top of the finished drink will be to the rim of the glass. This liquid line is called the **wash line**, and maintaining a proper wash line is essential to good bartending. In a professional setting, it is essential that your drinks be consistent. Having standard wash lines for each drink you prepare gives you an instant visual check that everything is okay. If your wash line is wrong, something is wrong with the drink. Consistent wash lines are also important to your guests' well-being. Two people get the same drink, but one drink sits higher in the glass: do you like the person with the taller pour more, or are your techniques just a bit shaky?

Advocates of the free-pour don't measure their drinks with measuring tools. Some free-pourers gauge how much they have poured by looking at the liquid levels on the side of glass mixing cups. These bartenders recognize through practice what liquid increments look like in a standard mixing glass. Other free-pourers use speed-pour bottle tops, which produce a steady stream of liquor. Speed-pour mavens judge how much they pour by counting off the length of time they pour: so many counts equals so many ounces. These bartenders practice for hours and hours to attain a consistent counting technique.

Why do free-pourers eschew measuring cups? There are four main schools of thought: the Lazy, the Speedy, the Artist, and the Monk. The Lazy just don't care if they are accurate; enough said about them. The Speedy believe that free-pouring is accurate enough and saves valuable time behind the bar—a couple seconds saved on each drink adds up to a lot of time when customers are six deep at a busy bar. The Lazy and the Speedy free-pourers won't achieve accurate and repeatable results. Free-pour techniques are particularly inappropriate for the home bartender, who doesn't pour out dozens of drinks each night, hasn't practiced a lot, and should be spending the time to get each drink right. Free-pour Artists believe that measuring cups make them look unskilled, unpracticed, and lacking in finesse. I disagree. Masterful jigger-work is a pleasure to behold, and being accurate doesn't make you robotic. No free-pourer can be as consistent over as many different drinks in as many different conditions as someone who measures. The most intriguing argument in favor of free-pouring comes from the Monk, who believes that drinks should not be constrained to easily remembered recipes given in quarter-ounce increments. After all, why should we believe that exact quarter-ounce increments provide the ideal proportions for a drink? Monks pour by feel, tasting as they go, establishing the correct proportions for each drink individually by intuition and by how they size up their guests' tastes.

The “wash line,” where I’m pointing, is where the top of a drink hits on the glass.

I like free-pour Monks, but in daily practice it is much better to have a standard recipe that you can remember and consistently follow than to worry about the constraints of the measuring system. Fixed recipes can still allow for nuance while taking advantage of standard measuring equipment and terms. While it is impossible to remember that a recipe should contain .833 ounces of lime juice (one-third of the way between ¾ ounce and 1 ounce), it’s easy to remember “a fat ¾.” Similarly, two-thirds of the way from ¾ to 1 ounce can be called out as a “short ounce.” Some recipes that call out even smaller quantities have smaller but easily remembered increments: we use the bar spoon, the dash, and the drop. In answer to the Monk’s main premise—that measuring doesn’t guarantee a perfectly balanced drink—the good measuring bartender tastes each and every drink he or she makes. The pros use a drinking straw to extract a small sample of each drink to ensure that the measured proportions have produced the required effect.

Notice that in the above discussion my units are in *ounces* and not in milliliters. American cocktail recipes are always written in ounces. Before my metric friends get in a tizzy, let me say that in a cocktail recipe the word *ounces* is really just another way to say "parts." Cocktail recipes are all about ratios, and ratio measurements are in parts: 2 parts booze plus ½ part syrup and ¾ part juice and the like. In this book, 1 part equals 1 ounce equals 30 milliliters. The size of an actual "ounce" depends on whom you ask. Even without considering the various now-obsolete international *ounce* definitions, the United States *by itself* has a bewildering array of differently sized "ounces" that all hover around 1 fluid ounce equaling 30 milliliters. It turns out that the 30 milliliter ounce is an extremely convenient part size for making cocktails. So when I am making individual drinks, I usually speak in ounces. When I'm making large batches, I use a calculator or spreadsheet to convert my ounce-based recipes to any size I need, and I calculate in milliliters at 30 milliliters to the ounce.

Remember! In this book, 1 ounce of liquid equals 30 milliliters.

IMPORTANT: UNITS IN THIS BOOK

In this book I always equate 1 ounce with 30 milliliters. My jiggers are sized this way as well. If you have a jigger set that uses a different-sized "ounce," your measurements will be consistently slightly different from mine—not usually a problem. Here's my decoder ring:

- Volume is (fluid) **ounces**, **milliliters** (ml), and **liters** (l); but in this book, a fluid ounce is 30 milliliters. Some bar-specific volume measurements in this book:
  - 1 bar spoon = 4 milliliters, a bit more than $^1/_8$ ounce
  - 1 dash = 0.8 milliliters, or 36 dashes to the ounce
  - 1 drop = .05 milliliters, or 20 drops to the milliliter and 600 drops to the ounce
- Weight is always in **grams** (g) and **kilograms** (kg), not ounces and pounds. The persnickety will note that, unlike the ounce, the gram isn't a unit of weight; it is a unit of mass. Weight is a measure of force. Force, not mass, is actually what a scale weighs. The unit of mass in imperial units is the awesomely evocative, seldom-used slug. Really our metric scales should weigh in newtons (kg x m/s^2)—but that's just dumb.
- Pressure is in **psi** (pounds per square inch) and **bars** (atmospheric pressure is roughly 14.5 psi or 1 bar).
- Temperature is in both **Celsius** (C) and **Fahrenheit** (F), although for cocktail work I vastly prefer Celsius. Fahrenheit's proper place is in weather forecasts, baking, and frying.
- Energy and heat are in **calories**. Sorry, science world, but calories make intuitive sense when you are heating and cooling water a lot of the time. The standard unit, the joule, does not. (One calorie equals 4.2 joules.)

EVERYDAY EQUIPMENT FOR MEASURING DRINKS

Individual drinks are usually measured with jiggers. The jigger set I like to use consists of two vessels, each a double cone. They follow the convention of the 30 milliliter “ounce.” The larger of the two jiggers, which I use for measuring anything between 1 and 2 ounces, has a 2-ounce cone with markings inside for 1½ ounces and a 1-ounce cone with markings inside for 3/4 ounce. The smaller jigger has a ¾-ounce cone with a ½-ounce internal line and a ½-ounce cone with a ¼-ounce internal line. These two jiggers are all you need for most measurements. If you are measuring to an internal line in the jigger, pour all the way to the line. If you are measuring to the top of the jigger, pour *all the way to the top*. People tend to underpour when they are measuring a full jigger. Tip: have your jigger over your mixing vessel as you pour to prevent yourself from spilling precious, precious booze.

Three jiggers and a graduated cylinder. Surprisingly, all three jiggers have the same volume. Because it is narrower, the tall one in back is much more accurate. The jigger in front is more accurate than the one on the left because its sides are straight near the top. The graduated cylinder is a paragon of accuracy.

Given a choice between tall, skinny jiggers and short, squat jiggers, I always choose the tall. They are far more accurate. A pour that’s a millimeter higher or lower in a wide jigger constitutes a much larger error than it does in a skinny jigger. The same principle applies to the next piece of equipment I recommend you acquire: a graduated cylinder.

Even with a tall, accurate jigger you must pour consistently to the top. The jigger on the left is holding 2 ounces (60 ml). The one on the right is short by a full $^1/_8$ ounce (3.75 ml).

FANCIER EQUIPMENT FOR MEASURING DRINKS

Graduated cylinders are tall, skinny, straight columns with milliliter volume measurements on the sides. They range from tiny 10-milliliter (about ⅓ ounce) guys to 4-liter behemoths. Graduates are very accurate. Measuring cups and beakers are sloppy by comparison. I use them for recipe development and for batching large quantities of cocktails accurately. The ones I use most are 50 ml, a little under 2 ounces, which is a good jigger replacement for fine-tuning a highly technical recipe or adding very concentrated flavors to large batches; 250 ml, a little more than 8 ounces, which is perfect for mixing up to four cocktails at a time or measuring the smaller-volume ingredients in larger batches; and 1 liter, a little more than 1 quart, for when I'm batching by the bottle. Clear unbreakable plastic versions are available at modest prices; glass ones cost more.

Most people won't need one, but I really love my micropipette. Micropipettes allow you to measure a small volume of liquid very quickly and very accurately. Mine is adjustable to measure any liquid amount between 1 ml and 5 ml and is accurate to .01 ml. Using one takes only seconds, and unlike digital scales, micropipettes require no batteries. We use one every day at Booker and Dax for juice clarification. I also use it for recipe testing on very concentrated flavors, such as concentrated phosphoric acid or quinine sulfate solution. I use a micropipette to help figure out the proper recipe by adding small, well-defined quantities bit by bit.

This micropipette can measure and dispense any volume between 1.00 ml and 5.00 ml.

EQUIPMENT FOR MAKING DRINKS

MIXING CUPS FOR STIRRED DRINKS

Mixing cups are a reflection of the bartender's personal style and can have a large effect on the finished cocktail. The most traditional mixing cup, a standard pint glass, has many advantages: it is cheap and fairly rugged, you can see through it, and it can be used for shaking. Many professional bartenders use pint glasses because they already have them on hand for serving beer. The main arguments against the pint glass are threefold: (1) they are made of glass (more on that in a minute); (2) they aren't supersexy; and (3) they have a rather narrow base, so they're easy to tip during a vigorous stirring bout.

Many fancy alternatives can combat the last two issues. The two most popular are the cut-glass crystal Japanese mixing cup, shaped like a beaker, and large, stemmed mixing glasses, which look a bit like squat, overgrown wineglasses. Many of my bartenders at Booker and Dax use the cut-crystal mixing glasses. They look great and have stable wide bases and useful pour spouts. They are also quite expensive, and only one careless drop away from the garbage bin.

A third option is a beaker from a scientific supply house, which makes a good, if goofy, mixing cup with a wide base and helpful, fairly accurate volume measurements on the side. These measurements are especially handy for the occasional home bartender, who doesn’t have the time or inclination to learn to equate volume and pour-height-in-the-glass by rote.

Fancy mixing cups are an investment. If you are making drinks in front of guests, nice gear enhances their experience and gives a better overall impression of you as a bartender, and can therefore increase the guests’ enjoyment of the drink. If you don’t plan to mix in front of your guests, don’t bother spending the extra cash.

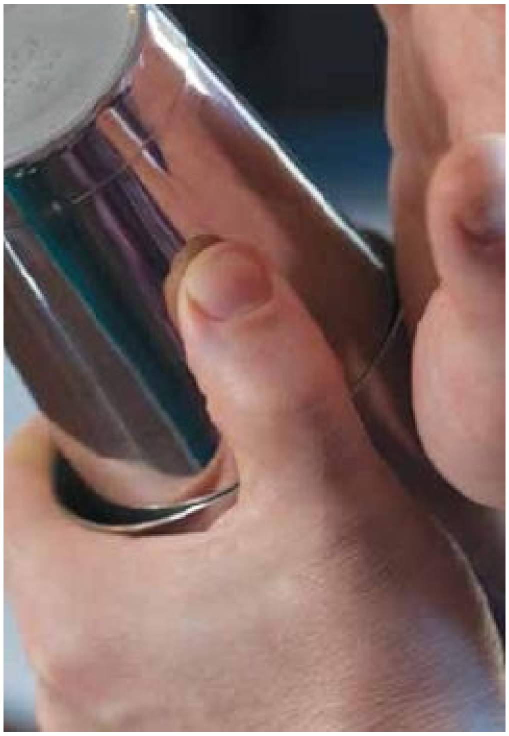
My preferred mixing vessel is affordable and unbreakable: an 18-ounce metal shaker commonly referred to as a tin, even though they are almost all made of stainless steel. I favor metal because it has a much lower specific heat than glass. It takes less energy to cool or heat a gram of stainless steel than a gram of glass. Most glass mixing cups are thicker, and weigh much more than the average 18-ounce metal tin, so you can see that glass mixing cups represent a significant thermal mass—one that will affect the temperature and dilution of your drink. If you were to stir two drinks, one in a chilled glass mixing cup and one in a room-temperature glass mixing cup, there would be a noticeable difference between the two. To make sure that your drinks are consistent (and consistency should be one of your main bar goals), you must either *always* use chilled mixing glasses, or *never* use prechilled mixing glasses, or be some kind of savant who can autocorrect between the two. Metal tins require so little energy to cool down or heat up that they have very little effect on your cocktail.

For stirring drinks I prefer the metal tin. The lovely glass vessels have a large thermal mass, which can throw off your chilling unless you consistently prechill them.

SHAKERS (LEFT TO RIGHT): *Three-piece cobbler shaker; Boston shaker with glass on metal; Boston shaker with metal on metal (my preference); two-piece Parisian shaker.*

This Parisian shaker is pretty cool looking, but is not as versatile or inexpensive as a standard set of metal shaking tins. You build your drink in the small, top section, add ice to it, and then tap the larger cup on top. As you shake, the cup will chill, contract, and seal around the top.

The cobbler shaker is good for people with small hands and people who like fancy-looking shakers. They are not very versatile and I dislike the integrated strainer.



To break a set of tins, smack the larger tin right where the seam between the two tins starts to turn into a gap.

COCKTAIL SHAKERS FOR SHAKEN DRINKS

Anyone even remotely interested in cocktails should own a set or two of cocktail shakers. The primary shaker criterion: it must withstand violent agitation without spilling liquids all over you and your guests. The two main styles of cocktail shaker are the three-piece and the two-piece. A third style, the Parisian shaker, looks really cool but is rather rare.

Three-piece shakers, or cobbler shakers, consist of a mixing cup, a top with an integral strainer, and a tiny cup-shaped cap sealer. You build the drink in the cup, add ice, put the sealed top onto the cup, shake, and then remove the top and strain into your glass through the integral strainer. These shakers come in a wide range of sizes, from single-drink shakers to large, multiliter party shakers. We don't use three-piece shakers at Booker and Dax, and I don't know many professional American bartenders who favor them. They don't strain as quickly as a two-piece setup, don't offer control over straining (more on that later), are prone to jamming after shaking, and are infuriatingly incompatible from set to set. You haven't had fun shaking drinks until you've had to shake a party's worth of cocktails with a random batch of nonstandard 3-piece shakers. Poorly made three-piece shakers—and most of them are—also tend to leak. On the upside, cobbler shakers, especially the small ones, are easier for bartenders with small hands to manipulate with skill and aplomb. Some bartenders who follow particular Japanese schools of bar artistry believe that the shape of the cobbler shaker improves the structure of the ice crystals produced while shaking; I think this is hokum. Nearly all professional three-piece shakers are made of metal, but there are exceptions. A bartender at one of the most renowned bars in Tokyo served me a cocktail from a neon-pink plastic cobbler shaker. The reason, a student of the Japanese school told me, is that the plastic, being soft, creates fewer and different ice crystals than a metal shaker would. I have yet to test this hypothesis, but I'm skeptical.

Two-piece shakers, or Boston shakers, are the most popular choice for professional bartenders in the United States. I use them at home and at work. They consist of two cups, one of which fits inside the other to form a seal. It is difficult to believe that a good seal will form the first time you use a Boston shaker—you fully expect to spray cocktail all over the room—but believe me, two-piece shakers seal reliably day in and night out. I'll save the physics for later. Metal-on-glass uses a large 28-ounce metal tin and a standard U.S. pint glass. You mix your cocktail in the glass part, then put the metal tin over the glass and shake. I don’t like the metal-on-glass setup because the pint glass might break, all that glass has a large thermal mass, and it’s hard to shake a metal-on-glass setup one-handed unless you have orangutan hands. Some people like the mixing glass because it lets them see how much liquid they have added to the cocktail. I don’t care about this, because I measure my cocktails. I prefer metal-on-metal shakers, specifically the two-piece type known as “a set of tins”—a 28-ounce tin and an 18-ounce tin. The 18-ounce tin is often called a “cheater” tin by the pros because in a pinch it can be used as a strainer. These suckers are indestructible, have a low thermal mass, are fairly easy to handle, and look and sound good while shaking. A set of tins has a large internal volume, so while making one drink at a time is the norm, making two drinks, even three, in one shaker is no sweat. You build the drink in the smaller tin, add ice to the rim, place the larger tin over the top, tap to initiate the seal, and shake. After shaking, you break (take apart) the tins. Good bartenders break their tins with much flair and an audible commanding crack that makes my mouth water as if I were one of Pavlov’s dogs. I myself am still working toward tin-breaking mastery. This is a skill you will never regret acquiring.

Until fairly recently, two-piece metal-on-metal tins weren’t easy to find as matched pairs. You needed to scrounge around kitchen and bar supply shops to find two tins that worked well together. Now it is easy to find tins that go together, seal well, and are stiff enough to give a nice break. Poor-quality tins with noodlelike flexibility are notoriously difficult to break; they just slide back and forth against each other.

STRAINERS

You need three different strainers for bar work: julep, hawthorn, and tea.

STRAINERS (CLOCKWISE FROM TOP): *Tea strainer; julep strainer; hawthorn strainer.*

Julep Strainer The julep strainer is an oval with rather large holes intended for straining stirred drinks. The large holes allow fast straining, and because the whole strainer fits inside the mixing cup, the pouring lip of the mixing cup is unobstructed.

Hawthorn Strainer The hawthorn strainer has a spring around its edge that lets it fit into a metal shaking tin and into many mixing glasses. In general, that spring makes the hawthorn better at straining out unwanted bits, such as chunks of mint and small ice pieces, than a julep strainer. Almost all hawthorn strainer springs, however, are too large to capture everything that the caring bartender worries about, so many bartenders use the hawthorn in tandem with a fine tea strainer. I use a Cocktail Kingdom hawthorn with a very fine spring that obviates that problem.

Some hawthorn strainers are made so that the flow of cocktail can be broken into two streams, enabling the bartender to pour two drinks at once, like a barista pouring two espresso shots into different demitasse cups.

Hawthorn strainers are more difficult to use than julep strainers because they sit on the outside of the cup and are prone to drips and spills, but in skilled hands they provide much more control than a julep strainer. The bartender uses his or her index finger to slide the strainer up and down, changing the width of the pouring gap between the hawthorn strainer and the cup. This action is called “adjusting the gate.” Pouring with a closed gate holds back ice crystals. Pouring with an open gate allows more ice crystals to float on top of your drink. I have been a party to many heated arguments about the merits and demerits of ice crystals on shaken drinks. For many years crystals were a strict no-no, a sign of poor craftsmanship. Today the tide has turned, and many people, including me, proudly proclaim their love of a beautiful, shimmering layer of crunchy crystals. The argument against the crystals is that they melt quickly to form unwanted excess dilution at the top of the drink. I say, Drink faster! Shaken drinks deteriorate immediately after they are shaken. Like cherry blossoms, they are dead before you know it. They should be made in small portions and consumed quickly.

This new hawthorn strainer has a very tightly wound spring for capturing small ice crystals that would make it through a standard hawthorn. Why have springs at all instead of mesh? Because the spring conforms to the shape of your mixing tin.

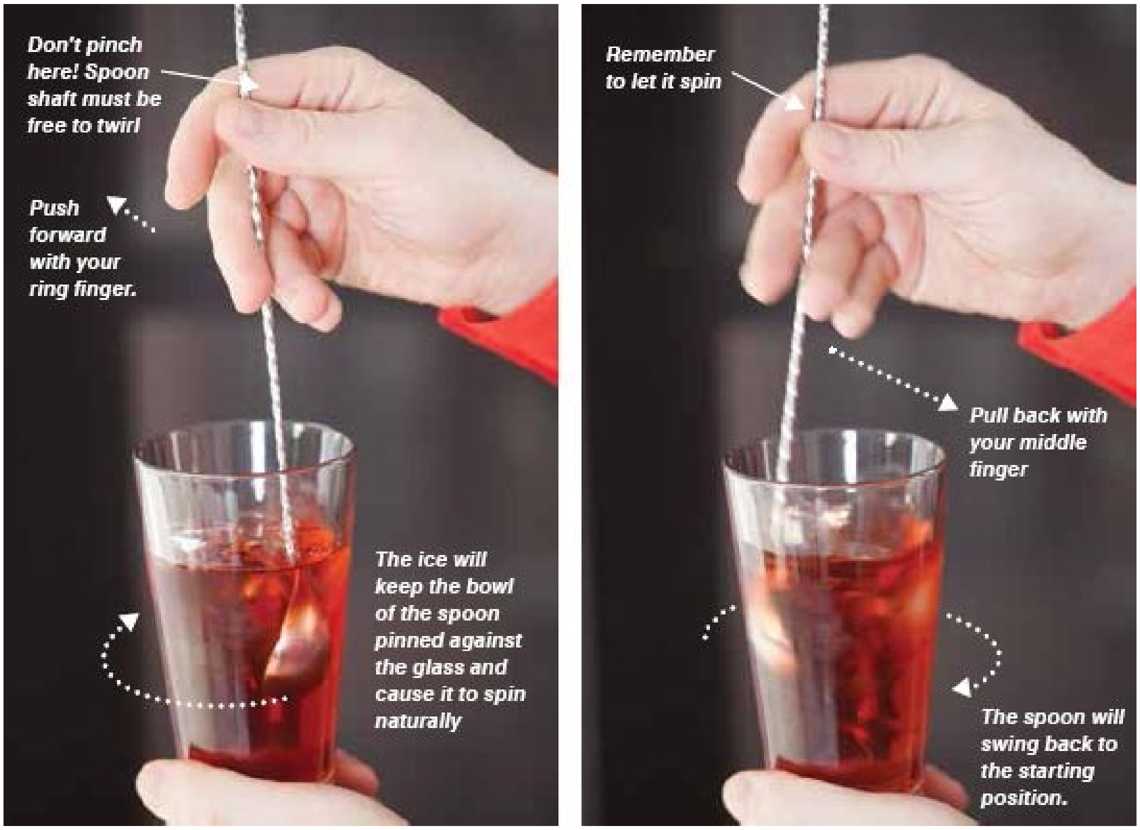
With practice you can use a hawthorn to pour into two glasses simultaneously. More of a gimmick for slow nights than a useful skill—but fun.

Tea Strainer The third strainer you'll need at the bar is a tea strainer, or any small fine-meshed strainer, to filter large particulates out of your drink. In the anti-ice-crystal days the bartender would use the tea strainer to insure that no ice particles entered the drink. At Booker and Dax, we use tea strainers to keep big herb particles out of our nitro-muddled drinks (see the section on nitro-muddling, here).

BAR SPOONS

Bar spoons are long, thin spoons that usually have a twisty shaft. Before I knew better, I thought they were dumb and unnecessary. I know now that these spoons make elegant stirring possible, and they make stirring results more repeatable. Nothing looks clumsier than a hamfisted stir. Believe me—I'm not very good at stirring and am often stirring next to masters. Great stirring technique appears effortless, and it is efficient and, above all, repeatable. Proper stirring requires precise repeatability. Really great stir fiends can accurately stir two drinks at a time. Some ninjas can do four. This sort of high stirring artistry cannot be performed with a run-of-the-mill teaspoon. You need a well-designed, well-balanced bar spoon with a shaft that suits your style. In addition to stirring, you can use your bar spoon to measure. The bar spoons I use are 4 ml (a little more than ⅛ ounce). Measure yours.

Another tip: use your bar spoon to fish the cherry or olive garnish out of that irritating jar. Don't use your fingers!



THE TRICK TO STIRRING*: simply push the bar spoon back and forth with your lower fingers while the top of the spoon rotates in the pocket between your thumb and pointer finger. Your hand never swirls around. Focus on always pushing the spoon against the inside wall of the glass—if the back of the spoon is in contact with the glass, the spoon will turn when you push.*

BAR MATS

Bar mats are one of those simple, life-changing things that have been completely overlooked by the home market. They are cheap and awesome. Made of thousands of tiny, 1/4-inch high rubber nubbins, they capture spills and are nonslip, preventing further spills. I don't care how good a bartender you are, you will spill stuff. When you spill onto a countertop, you look like a slob and your counter becomes slippery. When you spill into a bar mat, it looks like nothing has happened at all. The bar mat stays nonslip, no matter what. At the end of a night (or after a particularly bad spill), carefully pick up the mat, dump it into a sink, and rinse it off. Good as new. Bar mats also make primo drying mats for cups and dishware. Buy a bar mat.

PICTURED ON THE BAR MAT: 1) *Bad Ass Muddler (accept no other),* ***2)*** *a Kuhn-Rikon "Y" peeler (also accept no other— if you don't like this tool it's because you aren't using it properly),* ***3)*** *dasher tops,* ***4)*** *eye dropper, and* ***5)*** *a paring knife.*

MISCELLANY

If you are like me, you will acquire a wealth of little bar tools and gimcracks. Most of them are of limited use, but some are cool enough to search out.

Muddlers: Get a good muddler to smash ingredients in the bottom of a mixing cup. Most muddlers are crap—they don't have a big enough crushing area, so they just push ingredients around. One muddler stands out: the Bad Ass Muddler from Cocktail Kingdom. This large, solid cylinder lives up to its name. My second favorite muddler is a simple, straight-sided rolling pin. If you are going to muddle with liquid nitrogen, avoid cheap plastic or rubberized muddlers; the liquid nitrogen makes them brittle and shatter-prone (the Bad Ass Muddler is made of plastic but is unaffected by liquid nitrogen).

Misters: Little spray misters are occasionally useful for applying an aroma to a glass before pouring. Using one is more accurate and less wasteful than using the traditional rinse. Misters are also useful for applying aromatic oils or other ingredients to the top of a cocktail. I don't really use the misting technique, but many of my friends do.

Knives: You will want a decent paring knife to keep handy with your bar kit. Store it with a knife guard so that it doesn't get dull when tossed in among other bar wares. Invest in a small cutting board as well.

Droppers: Get a couple of glass bottles with screw-on eyedroppers. I use them to dose all kinds of liquids into cocktails in small amounts: saltwater, bitters, *etc*. If you like fancy-looking things, get some bitters bottles to add dashes bigger than drops but smaller than the contents of bar spoons. Be aware that different dasher tops have different dash sizes. At the bar we use a half-dasher and a full dasher. At home I just save old Tabasco and Angostura bottles, wash off the labels, and refill. I'm a frugal man.

Ice Storage: At the bar, our ice is stored in ice wells: large, insulated containers with integral drains. We use metal scoops or shaking tins to pick up the ice. At home, you'll need an ice bucket and a scoop or tongs. It's a bad idea to handle ice with your hands in front of guests unless they are close family. Unfortunately, I have never seen an ice bucket that I like. They should have a drain tap, like a water cooler, and a plastic rack to keep the ice from swimming in the meltwater. They should also look good.

Capper: If you are going to make bottled drinks, get yourself a handheld bottle capper. They are cheap and available at any home-brew shop.

EQUIPMENT FOR MEASURING, TESTING, AND MAKING INGREDIENTS

WEIGHT-MEASURING EQUIPMENT

Even though drinks should be measured by volume, it's useful to have scales (two, actually) for advanced bar work. Sugars for simple syrup, for instance, should be weighed. Hydrocolloids and other powdered ingredients should also be weighed. There is no reason to weigh anything in any unit other than the gram, and that is all you will see in this book. Water is the one liquid ingredient that can be easily converted from volume-to weight-based measurements—1 gram = 1 milliliter (at standard temperature)—and so I sometimes weigh my water (see the section on Calculating Dilution, here). Get two digital scales: one that can read in tenth-of-a-gram increments and one that can read in one-gram increments. For the smaller units, ask for a drug scale. If you just ask for a scale that can read by 1/10 gram, people always make the mistake of getting a scale that isn't accurate enough. If you ask for a drug scale, everyone knows you mean business when it comes to accuracy. Drug scales can be purchased very inexpensively. If you start playing with hydrocolloids and other new ingredients, or need to measure herbs for tinctures and the like, this scale will serve you well.

You will also want a scale that measures larger weights in 1-gram increments. Get one that will measure at least 5000 grams. You might wonder why you can’t get a scale that has a large capacity and also measures by tenth-of-a-gram increments. The answer is you can, if you have a lot of cash and patience—they cost a few thousand dollars and they are slow. Scales that measure large weights have large platforms. Large platforms are affected by wind currents. Even minor wind currents in a kitchen can make a large-platform scale fluctuate by a couple of tenths of a gram. Thus the two scales.

OTHER ANALYTICAL EQUIPMENT

Refractometers are instruments that measure refractive index, or how much light is bent as it enters a transparent substance. Because different concentrations of different substances dissolved in water bend light by a different and specific amount, refractometers can tell you the concentration of water-based solutions, such as the percent of sugar in syrups and fruit juices, alcohol levels in distilled beverages, and salt concentration in brines. Do you need one at home? Not really. But we use it every day at the bar, because I prize consistency.

Handheld refractometers like this one are pretty inexpensive. Be sure to get one that works in the range you need.

need.

Even though refractometers technically measure refractive index, that isn't what we care about—we care about how refractive index correlates to the concentration of whatever we're interested in: sugar, ethanol, salt, propylene glycol, whatever. So refractometers usually have scales that read in terms of those solutions. You can buy a refractometer for sugar, one for salt, and so on. The most common scale, and the most useful for the bar, is Brix, which is the measure of sucrose (table sugar) content by weight. Simple syrup with a Brix of 50 contains 50 grams of sugar in every 100-gram sample. That particular ratio is standard 1:1 simple syrup. Our rich simple syrup has a 2:1 sugar-to-water ratio and therefore a Brix of 66. Brix refractometers are a relatively cheap and easy way to standardize the syrups that you use. Want to make sure your honey syrup has the same sugar content as your simple syrup? Use a refractometer. Want to know how much sugar is in your fruit juice? Refractometer.

If you can spring for it, I recommend that you get yourself an electronic refractometer that can measure between 0 and 85 Brix. They are fast to use, even in a dark bar, and are accurate over their whole range. Traditional manual refractometers, which can be bought inexpensively, work fine. The trick with the nonelectronic jobs is making sure the Brix range they measure is sufficient. The most common range is 0–32 Brix, which is fine for any fruit juice work you do but won't work for syrups. You can buy a 0–80 or 0–90 manual unit, but then it is hard to read accurate numbers, because the scale on a 0–90 is the same size as the scale on a 0–32, making the 0–32 almost three times more accurate. Even so, if your primary use is at the bar, get a 0–80 Brix unit (make sure it is a Brix scale and not an alcohol scale). The other issue with manual refractometers is you need a light source to read them. It sucks trying to hold a flashlight up to the end of a refractometer stuck in your eye behind a dark bar during the press of a busy service. If you are on the fence about buying one, using a Brix refractometer is also helpful outside the bar, to standardize recipes for sorbet and the like when you are using ingredients like fruit with an unknown amount of sugar (these applications want a 0–32 Brix unit).

Caveat: it is extremely easy to misuse a refractometer. Brix scales assume that the only substances in your sample are sugar and water. For most products, like fruit juices, that assumption is okay because they don't contain a lot of salt, ethanol, or other ingredients that dork with refractive index. However, using a refractometer to measure liquids that are a mixture of sugar and ethanol *will not work*. Both alcohol concentration and sugar concentration affect refractive index; there is no way to know how much of each is present. Anything you measure with a refractometer must be considered a mixture of water and *one other substance only*.

Thermometers will be useful in the imbibing experiments that we will explore later in this book. Any relatively fast-acting digital thermometer that can reliably measure temperatures down to −20° Celsius (−4°F) is fine. I have a fancy eight-channel, data-logging, computer-connected, thermocouple thermometer. It's probably overkill for normal home use, but it's not very expensive, so you may want to try one.

pH meters are rarely useful for cocktail work, but people in the trade often ask me about them. A pH meter can measure how acidic an ingredient is but cannot predict how sour an ingredient will taste. See the Ingredients section, here, for more detail on this phenomenon.

JUICERS FOR LIMES AND LEMONS

Juicing small citrus is important to me. I joke that I don't respect people who can't juice quickly—but I'm not really joking. Forget hand reamers; they suck. Upright lever-pull citrus presses are good for grapefruits that won't fit in smaller hand presses, but they are slow. The best small-citrus press is the lowly swing-away hand press.

Many years ago I was taught the secrets of the hand press by my San Francisco bartender friend Ryan Fitzgerald. He is still faster than me, and I hate him for it. First, have all your citrus washed, cut, and in an easy-to-reach pile next to you on the counter. Right in front of that pile, have a wide bowl to catch the juice. Right next to the juice bowl, have something to catch the spent citrus. To juice, hold the press open in your weak hand. Quickly grab a citrus half with your strong hand and place it *cut face down* into the cup of the press. In one forceful and strong motion, use your strong hand to close the press and crush out all the juice in one violent spray into the bowl. Now flick the handle back sharply as your weak hand aims the cup of the press toward the spent citrus bowl. As the handle flies back and comes to a halt, the jerk that you created should pop the spent citrus into the waste container *without your touching it*. This is very important, because your strong hand should already be reaching for the next fruit. Done properly, you should be able to achieve juicing speeds in excess of 300 ml per minute. The trick to the technique is choosing the right press. Bad presses are too deep. Deep-cupped presses seem like they'd be good, but what you need for real speed-juicing is a shallow cup that can properly eject spents. Good action on the handle is also a must. Finally, the handle of the press should open only about 120 degrees; a press that opens all the way to 180 degrees or more is wasting movement and time.

JUICING LIMES LIKE A MACHINE: *Set up your station as shown so you can quickly grab fresh limes, with the juice-catcher and the spent-peel-catcher next to each other.* ***1)*** *Hold the juicer as shown with the lime face-down.* ***2)*** *Violently smash the hell out of the lime and then* ***3)*** *immediately throw open and release the handle. The force from the handle popping open will eject the spent peel into the waste bin while you are reaching for the next lime and placing it in the juicer. Repeat again and again and again . . .*

Why not use an electric juicer, you may ask. My favorite juicer used to be the Sunkist-style electric juicer. It is fast. With a two-handed grab-press-toss juicing technique, I can easily achieve 800 ml per minute or more. Juice flows from my hands like a mighty river on the Sunkist, with spent lime halves raining matrixlike into trashcans. The yield is 25 percent higher than with the hand press. The problem? The juice doesn't taste as good. In blind taste tests, people universally preferred the juice from a hand press over that obtained from the Sunkist, probably because the spinning reamer scrapes bitterness out of the white pith, or albedo, of the fruit. If you persist in using the Sunkist, do yourself a favor: rip out the goofy strainers. After 3 or 4 quarts of juice they clog up and are a pain to clean.

If unlike me, you have infinite money and space, you can use the Zumex automatic juicer favored by the godfather of juice himself, Don Lee, one of the masterminds of the cocktail world. Pour a box of washed but uncut citrus in, juice comes out. I could stare at that thing all day. Don uses it to make lime and lemon juice for the thousands of drinks served daily at the cocktail industry's yearly bacchanalia, Tales of the Cocktail, in New Orleans.

No matter how you press your citrus, you should stain it through a fine chinois or tea strainer before use. Large pulpy bits on the side of a cocktail glass look terrible.

JUICERS FOR LARGER CITRUS

For larger citrus fruits such as oranges and grapefruits, the vertical lever-pulled press, OrangeX or equivalent, is the best choice. It makes short work of large fruit. Get a heavy-duty one, because cheap ones break. It will also work on pomegranates.

JUICERS FOR OTHER FRUITS AND VEGETABLES

To juice hard fruits like apples, or veggies like carrots, I use a Champion Juicer. It's a workhorse that can take a severe beating and keep on juicing. It once helped me rapidly juice six cases of apples in a row without pausing. Its housing got so hot that it boiled the water I tried to cool it with—and kept right on juicing. I threw wet towels around the Champion so I could keep working, and it kept working right alongside me, sending steam out of the towels the whole time. I eventually melted the magnets on the safety interlock (put there so you can't grate your hand off), but the motor kept on chugging. This baby will juice just about anything except wheatgrass and sugarcane. It works great on things you might not expect, like horseradish and ginger.

If I were running a fresh juice business, I'd invest in a Nutrifaster juicer, the ones that look like chrome spaceships from the 1960s. Nutrifasters are amazing. They require no operator force to make juice (you have to push pretty hard on a Champion to go fast), but they cost ten times more than a Champion and take up twice the space.

BLENDERS

I use only Vita-Prep high-speed blenders. They have balls and a very intuitive interface: two paddle switches and a knob. Everyone loves the two paddle switches and a knob. I don't know anyone who bought a Vita-Prep and regretted it. Vitamix is the home version of the Vita-Prep—it's the same basic machine with a better warranty and a lower price tag. Home folks should go for the

Vitamix. If you’re a pro, you should spring for the Vita-Prep—you’ll void the warranty on the Vitamix if you use it in a professional setting. Though I love them, Vita-Preps aren’t perfect. Their pitcher chokes down toward the blade so thick products spin up and away from the blade, creating an airlock. This forces you to use the plunger that is sold with the unit to keep the blending going. Guess what always gets lost in a restaurant or bar? The dang plunger. The speed control knob, which I love, is implemented with a cheap potentiometer, which I hate. Over the years the potentiometer goes wonky and causes the speed of the blender to jump around wildly. It’s funny to get sprayed with the contents of a blender unexpectedly, right? I do not recommend the BarBoss, the unit the company makes specifically for bars. It doesn’t have a real speed control, just a timer. Good for a drone making smoothies, bad for everyone else.

The other megablender on the market, the Blendtec, has the power to go toe to toe with the Vita-Prep and has a well-shaped pitcher that doesn’t require a plunger (the lids on the Blendtecs I have used are wretched, however—they leak). You can see the Blendtec in the various “will it blend” videos that pepper the Internet. I cannot recommend these blenders, however, because their controls are bad for thinking people. Are you a smoothie robot who wants to make consistent smoothies without paying any attention at all? Get a Blendtec. I have pleaded with Blendtec to make a unit with controls built for cooks and bartenders with brains, to no avail.

If you don’t want to shell out hundreds of dollars for a blender, fear not. Cheaper blenders are worthwhile tools and will make most of the recipes in this book, but until I can find a cheap blender that can suck up a pitcher of liquid nitrogen without choking or blend a pound of bacon to a beautiful smooth paste, I will never go back.

STRAINERS FOR INGREDIENTS

If you make juices or infusions, you are going to need to strain them. The strainers I use, in order from coarsest to finest: china caps—large holes, fast-draining; fine chinois—fine mesh, slow; clean muslin cloth (not cheesecloth); and coffee filters. Don’t use a strainer finer than you need, because fine filters take longer. When you need a superfine strainer, like a coffee filter, strain your product through a coarser strainer first, or the fine one will choke up immediately. For juices or syrups I typically put a china cap inside a chinois and pour the juice through both at the same time, saving myself a step. I then decide if I need the muslin. Only as a last resort do I bust out the coffee filters, because they take so dang long.

STRAINING IMPLEMENTS FOR YOUR PREP WORK: *I use* ***1)*** *a coarse china cap and* ***2)*** *a fine chinois, sometimes in combination. These tools are very useful but not necessary—you can also use a standard kitchen strainer. I use* ***3)*** *coffee filters constantly, but don't enjoy them because they always clog. When I am straining a large amount of product I often go through five or six, one after another. A* ***4)*** *straining bag is a useful intermediate between a kitchen strainer and a coffee filter.*

There are very nice, overpriced, straining bags on the market called superbags that come in a range of mesh sizes from fine to very, very fine. They are useful as an alternative or adjunct to ordinary strainers and filters.

CENTRIFUGES

Years ago, when I started telling people to buy a centrifuge, they just laughed. Now more and more chefs and bartenders are using them for a very simple reason: they save time and money. I can use the centrifuge to convert 2.5 kilos of fresh strawberries into two liters of clear, pure strawberry juice in 20 minutes flat without adding any heat. That is a game-changing ability. Centrifuges aren't really home-friendly—*yet*. The ones I use are rather large, and can cost quite a bit. Centrifuges use centrifugal force to separate ingredients based on density. They can spin the pulp out of juices, spin the solids out of nut milks, spin the oil out of nut pastes, and squeeze the fluid out of almost anything you can blend. The heart of a centrifuge is its rotor, the thing that spins around. Most rotors are one of two styles: fixed and swinging bucket. Fixed rotors hold sample tubes rigidly and spin them about. Mixtures spun in these tubes form a solid pellet on the bottom side of the tube. Swinging-bucket rotors are what they sound like—swinging buckets on the end of spinning arms. The solids in a mixture inside a swinging-bucket rotor get smashed onto the bottom of the buckets.

A 3-liter, 4000 g, benchtop, swinging-bucket centrifuge.

Centrifuges vary wildly in capability, cost, and size. The centrifuge I use at Booker and Dax is a 3-liter benchtop centrifuge with a swinging-bucket rotor holding four 750 ml buckets. It has a refrigerator to keep my products cool (spinning rotors generate heat from friction, so refrigeration is nice but not necessary) and can produce four thousand times the force of gravity at a speed of 4000 rpm. The one at the bar costs $8000 new, but we bought a refurbished unit for $3000. In my test lab I use an identical one that I bought on eBay for $200, but I had to fix it up a bit, and it could break again at any moment. The 3-liter benchtop hits the sweet spot for kitchen-friendly centrifuges. Smaller units don't have the capacity to make them worthwhile. Slower units don't produce enough force to make them useful in a busy kitchen. Larger units are bigger, more expensive, and more dangerous without offering results that are much better. I have spent years perfecting recipes that work at 4000 g's or lower so that you don't have to go out and buy that 48,000-g model. The largest, fastest centrifuges produce so much force that if something goes wrong with them, they can rip themselves apart like a bomb.

The buckets for my centrifuge hold 750ml each. Notice the balance they are sitting on. Buckets that sit across from each other in the centrifuge must weigh the same amount or all hell breaks loose.

You should never buy a used high-speed or superspeed centrifuge unless you know what you are doing. These units have rotors that must be inspected and retired after a certain number of spins, and a used rotor rarely comes with a guarantee of how it has been used or treated. Most rotors are made of aluminum, which experiences fatigue after spinning, starting, and stopping year in and year out. That fatigue can cause the rotor to crack and then suddenly fly apart without warning. I once had a freestanding spinning rotor centrifuge that was totally unprotected, the SS1 superspeed centrifuge from Sorvall. Made in the 1950s when it was still okay to kill a lab tech every once and a while, that sucker could do 20,000 g’s and was little more than an aluminum rotor mounted on a motor with some legs bolted to it. Spinning that fifty-year-old aluminum rotor was the dumbest thing I’ve ever done in a kitchen, which is saying a lot. We called it the dangerfuge and immediately retired it to my bookshelf. Even on slower centrifuges, you should never use a rotor or buckets that are damaged or corroded in any way. An older motor or frame isn’t a safety issue on a centrifuge, but old rotors and buckets are. Consider getting a rotor that is guaranteed safe.

The second safety issue with used centrifuges is you don’t know what’s been in them. Assume the worst: prions, Ebola, whatever. The swinging-bucket types that I get are more often than not retired from labs doing bloodwork. I bleach the hell out of them when they show up, then pressure-sterilize the buckets in a home canning rig, then bleach the whole thing again. I call this procedure bleaching the rabies out.

For ambitious home enthusiasts, there is a worthwhile centrifuge unit selling now for under $200. It handles only 120 milliliters (a little over 4 ounces) at a time, and spins at only 1,300 times the force of gravity, but it can give you a realistic picture of what is possible with a centrifuge, weighs only 10 pounds, is the size of a toaster, and is safe.

This tiny centrifuge can be had for under $200. It works. It helps you make the same awesome cocktail stuff as the big one, just in very small quantities.

LIQUID NITROGEN

I love liquid nitrogen (LN or LN_2). Liquid nitrogen is liquefied nitrogen gas, which makes up three-quarters of the air we breathe. N_2 is in no way toxic. It is a chemical, just like the H_2O we drink is a chemical—which isn't to say you shouldn't be cautious when you use it. There are safety rules which must be followed at all times.

At −196° Celsius, liquid nitrogen can give you a nasty cold-burn. If you ingest it, the results can be catastrophic. Never serve or allow someone else to serve a drink that contains any cryogenic material, ever. Forget serving drinks with clouds of liquid nitrogen vapor emanating from them. While I'm at it, don't serve drinks with chunks of dry ice in them either. Ingested cryogens cause permanent damage. A young woman in England lost most of her stomach and was put in critical condition because a bartender thought it would be cool to serve a drink with some LN rolling around on top of it. It wasn't. In practice, it is easy to prevent customers from coming into contact with LN. You must always be vigilant.

Liquid nitrogen in the eyes can blind you. You must be extremely careful to prevent situations in which liquid nitrogen might get in someone's eyes. Never pour it over anyone's head, for instance. Some people recommend using gloves to handle liquid nitrogen. I don't. The only time I have been seriously burned with liquid nitrogen was when the cold made my glove so brittle that it cracked and allowed the liquid nitrogen to pour in. I couldn't shake the glove off fast enough to prevent a burn. You can, however, dip your hand directly into liquid nitrogen without getting frostbite. A layer of nitrogen vapor immediately forms around your hand, and that vapor temporarily protects you from the extreme cold. This phenomenon is called the Leidenfrost effect. You can observe it if you dump liquid nitrogen on the floor: it will roll around in little beads that skitter across the floor, almost frictionless, protected by a thin layer of nitrogen vapor, as when you throw a drop of water into a pan so hot that the water skitters around like a small marble rather than spreading out and boiling away. Remember, the Leidenfrost effect only helps you if a vapor can form between your hand and the nitrogen. Grab a superchilled metal cup and you are SOL.

When liquid nitrogen hits your hand it instantly vaporizes, forming a protective insulating vapor shield that prevents you from freezing. This is called the Leidenfrost effect.

More safety: just because liquid nitrogen isn't toxic doesn't mean it can't asphyxiate you. Large amounts of vaporizing nitrogen in a small space can displace oxygen—the oxygen you need to survive. Perversely, your body doesn't react negatively to oxygen deprivation. The panic you feel when you can't breathe isn't from lack of oxygen, it's from excess carbon dioxide (CO_2) in your blood. Trying to breath in a pure nitrogen environment doesn't cause an excess of CO_2 in your blood, so you feel great—loopy, in fact. Without extensive training (which some pilots go through), it is very difficult to self-diagnose a lack of oxygen. Breathing in pure nitrogen is much, much worse than breathing nothing at all. Your lungs aren't a one-way system for putting oxygen in your blood. They only function properly when the air contains more oxygen than your blood does. In a pure nitrogen environment, your blood contains more oxygen than the "air" in your lungs, and the oxygen is literally sucked out of your blood. Only a few breaths will take you out. The rule in industry is, don't try to rescue someone trapped in a nitrogen environment—he is already dead. For the good news, no cook or bartender has ever suffocated himself or herself with liquid nitrogen—yet. Don't travel with large amounts of liquid nitrogen in an elevator. Ever. An elevator is an enclosed space where, if your LN storage vessel failed catastrophically, you'd be trapped. Don't carry liquid nitrogen in a car with you. If you get in an accident and are knocked unconscious, you could be asphyxiated.

Yet more safety: liquid nitrogen should never be kept in a closed container. Ever. As liquid nitrogen boils in a room-temperature environment, it expands by almost seven-hundred times. Tremendous pressure will build up inside a sealed vessel as the gas expands—thousands of psi. Usually the vessel you have chosen won't withstand the pressure and will explode. A young cook in Germany was permanently maimed and almost killed this way in 2009, in a tragic accident that occurred because of a simple mistake.

So why use liquid nitrogen? It is mesmerizing, fantastic stuff. It can chill glasses almost instantly. It can chill and freeze herbs, fruits, drinks, and other products without contaminating or diluting them in any way. As I've said, I love liquid nitrogen, and I don't know anyone who uses it who doesn't. I like it so much that I worry myself. One further caveat: in general, liquid nitrogen isn't good for chilling single drinks; it is way too easy to overchill a drink using LN. A mildly overchilled drink might not taste good, but that scoop of frozen booze you might try to serve someone could be cold enough to burn the tongue. I've been served overchilled LN booze sorbets that have ruined my taste buds for the night.

Everyone I know gets liquid nitrogen delivered from a local welding supply shop. You store it in a piece of equipment called a dewar, an insulated vessel built to hold cryogenic fluids for a long time with minimal loss. Standard dewar sizes are 5, 10, 25, 35, 50, 160, 180, and 240 liters. At Booker and Dax we have a 160-liter dewar that our supplier refills every week. Larger amounts of liquid nitrogen are much more economical than smaller amounts. It costs me only $120 to fill my 160 but over $80 to fill a 35-liter dewar. The large dewars are also economical to rent; a small monthly fee and a hefty up-front deposit are all that is required to start using liquid nitrogen. A properly functioning 160-liter dewar will hold liquid nitrogen a long time before all the liquid evaporates away. If you have any skills with a torch at all, avoid the costly takeoff hose the company will try to sell you; make your own from commonly available copper parts. One more note: large LN dewars are kept under a small amount of pressure, typically 22 psi. This pressure provides the force for removing the liquid from the dewar. To maintain that 22 psi, the dewar has a relief valve that occasionally opens up and relieves excess pressure, making a hissing sound. The hissing really freaks people out. I reassure people by smiling and saying, "If it didn't hiss, we'd all blow up."

To dispense liquid nitrogen out of your tanks, don't bother with the expensive hoses the LN folks try to sell you. You can make your own takeoffs from readily available copper pipe and copper fittings sweated together with lead-free solder. The doo-dad at the end is a sintered bronze muffler. It costs less than $9. If you call that same thing a cryogenic phase separator, it costs $135.

We also have smaller 5-and 10-liter dewars that we use to shuttle LN around the bar during service. They are pretty pricey, a couple hundred bucks each. What we actually use to pour LN into drinks and glasses are vacuum-insulated coffee carafes and camp thermoses—unsealed, of course. Avoid carafes with a lot of plastic near the pour spout—they won’t last long.

DRY ICE

Dry ice, the other cryogenic cooking material, made of solidified carbon dioxide, is not nearly as useful as liquid nitrogen. It seems attractive. While dry ice is considerably warmer than liquid nitrogen, at −78.5°C, it has considerably more chilling power per pound. Dry ice is also easier to buy and has fewer safety concerns than LN does, but it loses out because it is a solid. You cannot immerse foods in dry ice. Dry ice mixed into liquids doesn’t disappear as quickly as LN does. You can’t chill glasses very well with chunks of dry ice. Also, carbon dioxide gas is soluble in water. If you aren’t careful, that drink you chill with a chunk of dry ice might get a little carbonated. I primarily use dry ice to maintain the temperature of large batches of drinks at events (see the Alternative Chilling section, here).

iSi CREAM WHIPPERS

I love my whippers. They have three main uses at a bar: making foams (which I don’t do), infusing nitrogen rapidly, and, in a pinch, carbonating. The best whippers I’ve used are made by the iSi company. Cheaper whippers often leak, and some really bad ones lack the safety features that iSi builds in.

Essentially, whippers are metal pressure vessels that enable you to pressurize liquids with a gas. The gas comes in small, 7.5-gram cartridges. You can buy either carbon dioxide cartridges or nitrous oxide (N_2O) cartridges. The bubbles from CO_2 make things taste carbonated, like seltzer, while the bubbles from N_2O are a bit sweet and not at all prickly. N_2O is also known as laughing gas, so some people use it as a drug, in which case the cartridges are known as whippets. N_2O is the gas I use most often at the bar because I use it for infusions, to which I don’t want to add residual carbonation.

The main downside of whippers is the high cost of the cartridges. Even though they cost less than a dollar apiece, I often use two or three at a time, and costs add up. In fact, companies like iSi aren’t really making much money on the whipper; they want you to buy the cartridges. A last note on cartridges: you may not bring them on airplanes, even as checked luggage, because they are considered pressure vessels. This fact has always amused me, because almost every seat in an airplane has a life vest under it powered by—guess what? An iSi compressed gas cartridge.

CARBON DIOXIDE GAS AND PARAPHERNALIA

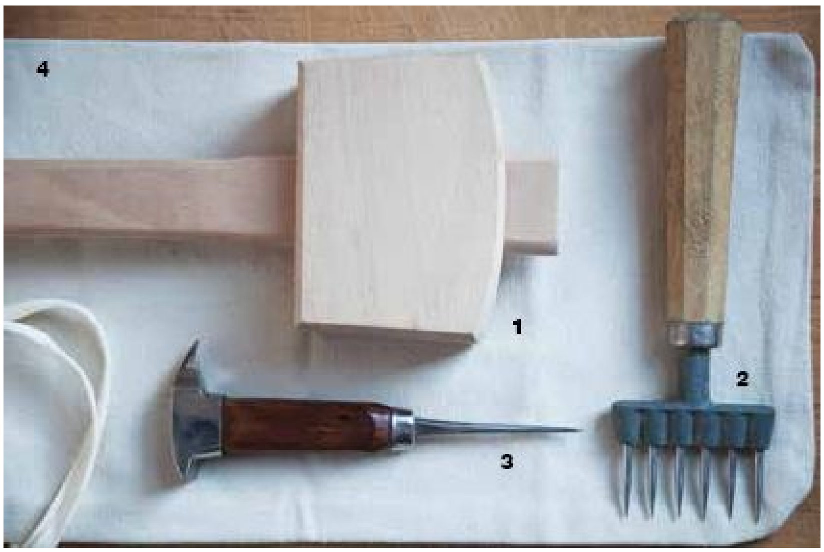
Carbon dioxide is the gas used to carbonate drinks. Ten years ago there were two main options available for carbonation: soda siphons (which work poorly) and commercial carbonation rigs (for making soda in bars). Around 2005 I became aware of the carbonator cap made by the Liquid Bread company. Liquid Bread was started by home-brew nuts who wanted a way to take samples of home-brewed beer to competitions and their buddies without losing carbonation. They developed a plastic cap that fits on ordinary soda bottles and easily hooks up to a CO_2 line via a cheap ball-lock connector obtainable from any home-brew shop. I started using that cap to carbonate cocktails, and it changed my world. There are now tons of options for carbonating at homes and at bars, and I have used many of them. None beats the carbonator cap. Other systems look better and use nicer-looking containers, but I’ve never had bubbles that I really liked out of any other system. As you’ll see later in the Carbonation section, I’m a bit of a bubble nut.

The whole carbonator-cap system is pretty inexpensive. All you need, besides the cap and connector, are a length of gas hose, a regulator, and a 5-or 20-pound CO_2 tank. The 5-pounder is small and easy to lug around and, depending on your technique, will carbonate between 75 and 375 liters (20–100 gallons) of liquid. A 20-pound tank isn’t easy to lug around, but it will fit in a standard home under-counter cabinet. A word of caution: you should use a chain or strap to prevent your tanks from falling over. CO_2 tanks are easily refilled at any welding shop. In fact, you can buy your tanks at the local welding shop, but it is often cheaper to buy them online; they are shipped empty. When you buy a regulator, make sure you buy a pressure regulator and not a flow regulator, because the latter won’t work. Also make sure you get a regulator that can produce at least 60, and preferably 100 psi (the higher pressure will be handy if you take up soda kegging as a hobby). Lower-pressure beer regulators will not work.

ICE TOOLS

I am a fan of shaking with large ice cubes. You can purchase silicone molds that make six 2-inch-by-2-inch square ice cubes that work great for shaking. Those molds will not produce the crystal-clear-presentation ice I use for my rocks drinks; for those you’ll need a rectangular Igloo cooler or other insulated container that fits in your freezer. To work with ice, I use two styles of ice pick:

a multipronged pick and a single-pointed pick. Both are of very high quality. Stay away from cheap ice picks; they will bend and frustrate you. I use an inexpensive flat-bladed slicing knife in conjunction with my ice picks to break large ice into smaller pieces in a controlled fashion. You should have some way to make crushed ice as well. The fancy way is to get a sturdy canvas bag called a Lewis bag and a wooden ice mallet to crush your ice right before you need it. The canvas soaks up melting water so your crushed ice is relatively dry. I also use an old-school Metrokane crank-style ice crusher to make what I call pebble ice, which is a bit larger-grained than crushed ice from a Lewis bag.



ICE TOOLS (CLOCKWISE FROM TOP): 1) *Ice mallet,* ***2)*** *multiprong ice chipper, and* ***3)*** *ice pick on top of* ***4)*** *a Lewis bag. Use the mallet to knock on a knife when cutting large blocks of ice, or to smash ice cubes that you put in your Lewis bag. It's better to crush ice in a Lewis bag than a plastic bag because the Lewis bag is absorbent and will yield dry crushed ice. Crushing in a cloth napkin also works, but the bag prevents ice from flying around the room. The ice pick at the bottom and ice chipper on the right are high-quality tools—avoid low-quality substitutes.*

For shaved-ice drinks, which I enjoy immensely, I use a hand-cranked Hatsuyuki ice shaver—a thing of beauty. Swan makes a similar model. For pros, I recommend getting one of these. I like just looking at the cast-iron lines of my Hatsuyuki. It makes no noise, something I prize behind the bar. The noise from shaking a drink: inviting; the noise from whirring electric machinery: not so much. These shavers provide very fine control over the texture of the shaved ice. They shave blocks of ice, not small cubes. The cheapest way to make the blocks is to freeze small plastic soup tubs full of water.

For the budget-conscious, some remarkably cheap professional-size electric ice shavers are on the market now and perform admirably well, but they look kind of junky. It’d be worthwhile to get one of these for a shaved-ice party at home, as long as you have room to store the shaver afterward. You wouldn’t want one on your counter. On the very inexpensive end, you can purchase hand ice shavers that look like little block planes. They are hard to adjust properly and are usually of poor quality. In my experience, you can get them to work, but they are a pain in the butt. Apparently, I’m just incompetent at using them, however, because every octogenarian street-corner shaved-ice peddler in my Lower East Side neighborhood seems to have no problem with them. If you really have patience, there is always the Snoopy Sno-Cone Machine and its modern equivalents.

Hatsuyuki manual ice shaver–a thing of beauty and silence.

REFRIGERATION

At the bar I use very accurate Randell FX fridge/freezers to chill my carbonated drinks and bottled cocktails. The FX can maintain any temperature I want between −4°F (−20°C) and 50°F (10°C) within 2°F. I’m very particular about the temperature of my drinks. Without the FX, it would be difficult to maintain the quality of my prebatched drinks. I have one set to 18°F (−8°C) which I like for carbonated drinks, and one set to 22°F (−5.5°C), which is the temperature I like for my stirred-drink-style bottled cocktails. Regular refrigerators are too warm for either of these applications, and freezers are too cold. I can’t stress enough how important accurate drink temperature control is to the functioning of the bar.

RED-HOT POKER

I build red-hot pokers to ignite and heat drinks at my bar. For why, and how to do it yourself, see the Red-Hot Pokers section, here.

VACUUM MACHINE

Vacuum machines are designed to seal foods in vacuum bags for preservation and *sous vide* cooking. For cocktails, I use them to infuse flavors into fruits and vegetables. Good machines are pricey—well over a thousand dollars—although you can play around with vacuum infusion for much less money.

ROTARY EVAPORATOR

The rotary evaporator, or rotovap as it's called in the biz, is a piece of laboratory equipment that enables you to distill in a vacuum instead of at atmospheric pressure. This is a good thing, for several reasons.

In distillation you boil a mixture of ingredients—typically water, alcohol, flavors, and (unavoidably) impurities—and convert a portion of that mixture into vapor. Everything that *can* boil in the liquid will be present in the resulting vapor to some degree, but the concentration of substances with lower boiling points, like alcohol and aromatics, will be higher in the vapor than it was in the liquid. The alcohol and flavor-enriched vapor then feeds into an area called the condenser, where it cools down and condenses back into a liquid.

In *atmospheric pressure distillation*, this process occurs at elevated temperatures in the presence of oxygen. In *vacuum distillation*, boiling occurs at lower temperatures, even at room temperature or lower, because reducing pressure reduces the boiling point. Vacuum distillation, therefore, is very gentle, because it happens at low temperatures and in a reduced-oxygen environment that prevents ingredients from oxidizing.

Another nifty feature of the rotovap is its rotating distillation flask. The rotation creates a tremendous fresh liquid surface area, which enhances distillation and promotes gentle, even heating of the mixture. Strangely, even if you are distilling at room temperature, you need to add heat. If you don't add heat, the mixture will cool down as it distills because of evaporative cooling. If you had a good enough vacuum, you could even freeze the mixture this way.

ROTARY EVAPORATOR: *You place liquid in the distillation flask (colored red) where it is warmed by a water bath, which is shown unfilled in this illustration for clarity. The distillation flask rotates to promote even heating and distillation. The vapor travels from the distillation flask to the condenser area (colored blue), where it is cooled and either condenses back to a liquid or is frozen solid on the condenser, depending on conditions. This particular condenser is cooled with liquid nitrogen. Anything that remains liquid after condensing drips into the receiving flask (colored green.) The entire process takes place at low temperatures because the system is kept under vacuum by a vacuum pump (colored yellow.)*

Why Use One: The Good: Rotary evaporation can make distillates of fresh products that taste fresher and cleaner than you'd think possible.Properly used, rotovaps can recover nearly all the flavors of the original mixture. Unlike atmospheric stills, they can split flavors without changing them or losing them.

I’ve distilled mixtures, recombined the leftovers with the distillate, and then blind-tasted against the undistilled liquid: people cannot tell them apart. The rotary evaporator is like a flavor scalpel. Use it artfully, and it allows you to manipulate flavors like no other piece of equipment.

The rotovap has taught me to think about flavors in new ways. My favorite uses highlight how your brain integrates complex flavor inputs. A distillation of red habanero peppers smells like it will kill you with spice but isn’t spicy at all, because capsaicin, the chemical that causes the burn, does not distill. Cacao distillates taste like pure chocolate but lack the inherent bitterness of unsweetened chocolate because the bitter principles don’t distill. I’ve made distillations of herbs and broken the flavors down into dozens of fractions that I can recombine however I like. Flavor scalpel. I love my rotovap.

My rotovap flying along.

Sometimes you don’t want the distillate, you want the leftovers. Imagine the freshness and punch of concentrated strawberry syrup that has never been heated. Simply remove the water from fresh clarified strawberry juice using the rotary evaporator. Delicious. Port wine reductions done at room temperature? Ridiculous (don’t forget to drink the port “brandy”).

The Bad: Unfortunately, rotovaps have some problems that will keep them from landing in most homes anytime soon. First, they are expensive: fully decked out, they cost well over ten grand. The cheaper ones are horrible, often leaky and therefore useless. Second, rotovaps are very fragile because of all the fancy glassware they contain. When you break a piece of glass in a rotovap—

and you will—it'll set you back a couple hundred bucks. Third, there is a steep learning curve to achieving good results. You'll get okay results quickly enough, but a novice operator will never produce products as good as those made by someone who's been flying the rotovap for years.

The Ugly: Last, laws prevent the distillation of alcohol in bars here in the United States. Consequently, many rotovap owners are constrained to distilling only water-based mixtures—no alcohol. Standard rotovap setups are woefully inadequate to produce decent results without ethanol. Water just doesn't hold on to flavors the way ethanol does, and the majority of the delicate aromas the rotovap is such a genius at capturing are lost. I have worked long and hard to produce good water-based distillates. You must use a condenser filled with liquid nitrogen that freezes all the flavor compounds solid so they cannot escape. After you finish distilling, you melt your frozen flavor directly into high-proof ethanol. A pain. The upshot of this gloomy graph is that while I would like to write a whole chapter on the rotovap—it is worthy—the world hasn't caught up to it yet.

SHOPPING LISTS

These shopping lists will help you navigate the maze of cocktail equipment. They are organized by desires and needs. Don't want to make carbonated drinks? Skip the bubbles section. Want to try carbonation but don't want to buy the rig on my list? I'll give other options later. The only mandatory shopping list is the first one. After you have your basic setup, you can add equipment from other lists as you wish. Sources for most of these items can be found in the section here. Photographs of many of the items appear here.

Remember not to get discouraged by the daunting nature of some of the equipment. In the techniques section of the book, I always try to give you a way to test cool techniques without breaking the bank.

HEY, I JUST WANNA MAKE SOME GOOD DRINKS

1. Two sets of shaking tins
2. Good jigger set
3. a) Hawthorn strainer, b) julep strainer, and c) tea strainer
4. Muddler
5. Paring knife
6. Y-peeler
7. Bar spoon

I WANNA ACT LIKE A FANCY PRO WITHOUT BREAKING THE BANK

Add:

8. Bar mat
9. Good ice pick
10. Dasher tops for bitters
11. Flat-bladed slicing knife (for ice) (not pictured)
12. Ice bucket and scoop (not pictured)
13. 2-inch ice-cube molds
14. Small rectangular Igloo cooler (not pictured)
15. Glass bottles with eyedroppers
16. Hand citrus press
17. Lewis bag or other ice crusher (not pictured)

THIS IS GOOD FOR MY KITCHEN TOO

Add:

18. High-speed blender, like a Vita-Prep
19. iSi whipped cream siphon
20. If you plan on making a lot of juice, a Champion juicer or equivalent

I'M GONNA MAKE SOME RECIPES THAT REQUIRE ACCURACY

Add:

21. Drug scale: 250 grams by the 1/10 gram
22. Kitchen scale: 5 kilos by the gram
23. Decent digital thermometer
24. Money permitting, 50 ml, 250 ml, and 1000 ml plastic graduated cylinders

BUBBLES

Add:

25. 5-or 20-pound CO_2 tank
26. Regulator, hose, ball-lock connector
27. Three Liquid Bread carbonator caps

I'M AN EXPERIMENTER OR A STICKLER FOR ACCURACY

Add, in this order:

28. Refractometer
29. Micropipette

I'M CRAZY

Add:

30. Professional ice shaver
31. Red-hot poker

I'M NOT BANKRUPT YET: BIG-TICKET TECH I'M GONNA GET ONE AT A TIME, IF EVER

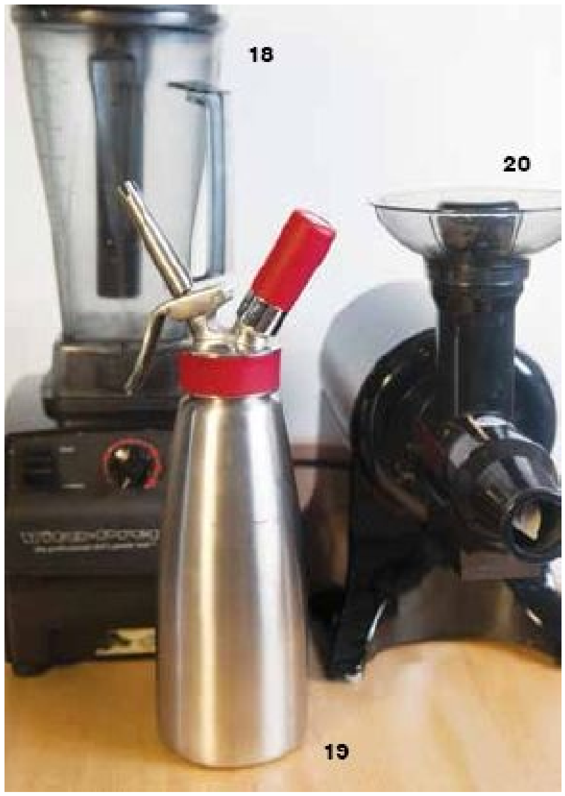
Add in this order:

32. Liquid nitrogen

33. Vacuum machine
34. Centrifuge (add this first if you are buying for a professional bar)
35. Rotary evaporator

BASIC BAR KIT: *If you have everything in this picture you can execute any classic cocktail with style and grace.*

IF YOU WANT TO ACT LIKE A FANCY PRO: *Get a bar-mat to capture unsightly drips and spills; a set* *of two-inch ice-cube molds to make big ice for shaking (you can use these cubes for rocks drinks as well); ice picks to work with larger ice cubes and chunks; dasher tops to make your own bitters bottles; an eye dropper for saline solution or tinctures; and a hand citrus press—because squeezing citrus between your hands or reaming with a fork is goofy.*



GOOD TO HAVE (LEFT TO RIGHT): *Vita-Prep (Vitamix for home use)—if you can afford it, the only blender you should buy; ½-liter iSi cream whipper; Champion juicer.*

PART 2

TRADITIONAL COCKTAILS

Our investigation of cocktails begins where it must: with the basics. When I say traditional cocktails, I don’t mean classic cocktails. I mean cocktails whose production requires nothing more than ice, booze, mixers, and a modicum of equipment—shakers, mixing glasses, spoons, and strainers. Generations of bartenders have developed thousands of delectable cocktails with these simple building blocks.

Section 1 deals with the science, production, and use of ice, the way ice interacts with booze, and the Fundamental Law of Cocktails.

Section 2 deals with shaken and stirred, built and blended drinks, with a final word on the underlying structure of all cocktail recipes.

Cocktail Calculus: The Inner Workings of Recipes

I recently constructed a database of cocktail recipes, including both classics and my own, so I could analyze them for ethanol content, sugar, acidity, and dilution. Each drink category—built, stirred, shaken, blended, and carbonated (which we will discuss later)—has clear, well-defined relationships between the characteristics, regardless of the flavors in a particular recipe. This might seem obvious, but the implications are not. I discovered that given a set of ingredients and a style of drink, I can write a decent recipe without tasting along the way at all. I have tested this process dozens of times, and I am shocked at how close I can get to the desired result strictly through applying the math. Bitterness is a bit of a wild card—very hard to quantify. Thank God something is.

I'm not talking about swapping rum for gin or lemon for lime. I'm talking about this: given apple juice, bourbon, Cointreau, and lemons, can I make a recipe with the same basic profile as a daiquiri by plugging in a few numbers? Yes, I can. It won't taste like a daiquiri, but it will have the same feel. I developed several recipes in this book mathematically, but I won't tell you which ones for fear you'll be prejudiced against them.

I don't really know how I feel about this ability. It's a little disconcerting. I tell myself that I still need to understand how flavors work together, I still need a brain and a palate—and that's true. All the math in the world won't help you if you can't put good flavors together. And the math isn't always right, either. Some drinks are better with more than average sugar or acid, some with less. The math will only give you the backbone of the drink—its structure. The soul of the drink will be the aromatics and flavors you choose. But the math has been incredibly useful to me for judging existing cocktail recipes and for developing my own.

It is easy to replicate the basic profile of a recipe you like in a new drink so long as you know the alcohol, sugar, and acid contents of your ingredients and target alcohol, sugar, acid, and dilution numbers for the recipe profile you want to emulate. To that end, my recipes specify alcohol content, sugar content, acidity, and final beverage size. To calculate new recipes of your own based on my numbers, you'll need to be armed with a list of the alcohol, sugar, and acid content of basic ingredients that I've provided here.

- Ethanol is measured in percentage alcohol by volume.
- Sugar is measured in grams per 100 milliliters, abbreviated g/100 ml, which is roughly equivalent to "percentage." This might seem like a bizarre measurement, but weight-in-volume measurements like g/100 ml are the only way to deal with dissolved solids such as sugar that must be measured volumetrically.
- Acid is quoted as a simple percentage. Although the same solid-in-liquid problem exists for acid as for sugar, the difference between actual percentage and grams per 100 ml is very small at the low concentrations of acid present in drinks (usually roughly an order of magnitude lower than the concentration of sugar) and percentage numbers are simpler to think about.
- Volumes are measured in ounces (remember, 30 milliliters to the ounce in this book) and milliliters.
- Dilution is measured in percentage. If I quote a dilution of 50 percent, that means that every 100 ml of original cocktail recipe will be diluted with 50 ml of water from melted ice for a finished drink size of 150 ml. If I quote a 25 percent dilution, that means that every 100 ml original cocktail recipe produces 25 ml of dilution from melted ice for a finished drink size of 125 ml.

HOW TEMPERATURE, DILUTION, AND INGREDIENTS WORK TOGETHER

Ethanol: Cocktail styles ordered by alcohol from most boozy to least gives you this list: built, stirred, shaken, shaken egg white, and blender and carbonated tied for last. This same order, with the exception of carbonated and egg-white drinks, sorts cocktails from warmest to coldest. You might expect the opposite—drinks with lots of ethanol seem as if they would be served colder instead of warmer, since chilling is often used as a way to mitigate high alcohol content. When you drink straight shots of vodka, they are chilled to extremely low temperatures—well below any cocktail temperature—to kill the sting of the alcohol. But the opposite is true for cocktail recipes. Why? Because of the Fundamental Law of Traditional Cocktails (see here). Making a high ethanol drink means having less dilution.

Since dilution and chilling are linked by the Fundamental Law, this low dilution corresponds to warmer temperatures. The nature of different drink styles is built into the physics of chilling with ice. We feel that high-alcohol built and stirred drinks taste good warmer, and the flavors of fine liquors in those drinks would be ruined by lower temperatures, but it is hard to decipher which came first, our preferences or the physics.

Drinks with higher initial alcohol content will dilute more per unit volume than drinks with lower initial alcohol content (and they will get colder as well, by the Fundamental Law). The limiting case is trying to chill a juice with ice (which doesn't get very diluted) and trying to chill pure ethanol with ice (which gets very, very diluted). The diluted pure ethanol will always have a higher alcohol percentage than the diluted water, even though it dilutes much more.

Sugar: Remembering that our perception of sweetness is radically dulled by cold, so you would expect sugar levels to be higher in colder shaken drinks than in warmer stirred drinks to achieve the same sweetness on our palate—and they are. Built drinks, which are warmest, have the least added sugar, but because they have so little dilution, they often end up with more sugar per unit volume than stirred drinks.

Acid: Your perception of acid isn't affected as much by temperature as your perception of sugar is, and acid flavor doesn't attenuate as quickly as sugar during dilution. Highly diluted cold drinks, like blended drinks, will have less acid per unit of sugar than warmer, less diluted shaken drinks. Stirred drinks typically contain less acid than shaken, blender, or carbonated drinks, not because of their temperature or sugar content, but because they are not usually supposed to be tart. Built drinks contain very little or no acid.

Flavor Concentration and Sugar-to-Acid Ratio: Flavor concentration is a measure of how much sugar and acid are present in a drink relative to its dilution. It is hard to quantify, because it deals with two different ingredients, sugar and acid. Usually more diluted drinks, such as carbonated and blended drinks, have an overall lower flavor concentration than higher-alcohol drinks. The ratio of sugar to acid that will achieve the particular balance of sweet and tart you desire in a recipe will change, as stated above, depending on a drink's service temperature and its dilution.

CALCULATING DILUTION

After lots of testing, I came up with an equation to estimate dilution from stirring and shaking that takes only initial alcohol content into consideration. It works well for the range of alcohol content in cocktails. I discovered that I could safely ignore sugar content. In these equations, alcohol by volume must be input as a decimal (22 percent would be 0.22) and dilution is returned as a decimal percent. I derived these equations by measuring a series of cocktails and using Excel to fit a curve to my data.

Dilution of a stirred drink stirred quickly with 120 grams of ¼-inch cubes for 15 seconds: Dilution ratio = $-1.21 \times ABV^2 + 1.246 \times ABV + 0.145$

Dilution of a shaken drink shaken with 120 grams of ¼-inch cubes for 10 seconds: Dilution ratio = $1.567 \times ABV^2 + 1.742 \times ABV + 0.203$

STRUCTURE OF DIFFERENT TYPES OF DRINKS

These guidelines for specific drink styles are based on my analysis of forty-five classic cocktails—built, stirred, shaken, and shaken with egg white—and ten carbonated and blender recipes of my own. In the chart here and accompanying recipe sheet here you can peruse all the values for yourself. All the numbers represent typical ranges, not hard-and-fast rules, and I ignore outliers in the typical ranges that I present.

BUILT DRINKS: Built drinks are typically almost entirely liquor, so their alcohol by volume is very dependent on the strength of their base liquor. Because they are sipping drinks served on a rock, built drinks must taste good over a range of dilutions. This range makes it impossible to come up with a good sugar-to-acid ratio—the proper ratio would constantly change as dilution changed. As a result, built drinks typically contain little or no acid.

Recipe volume: 2⅓– 2½ ounces (70–75 ml) **Initial alcohol by volume:** 34–40%
Initial sugar and acid content: roughly 9.5 g/100 ml sugar, no acid **Dilution:** roughly 24%
Finished drink volume: 2⁹⁄₁₀–3¹⁄₁₀ ounces (88–93 ml) **Finished alcohol by volume:** 27–32%
Finished sugar and acid content: roughly 7.6 g/100 ml sugar, no acid

STIRRED DRINKS: Stirred drinks usually have some acidity, but are not tart. They have a wider range of alcohol levels than other drinks do.

The sixteen drinks I analyzed range between 21% and 29%, with one outlier, the widow's kiss, at 32%. The Negroni is the lowest-alcohol stirred drink. Perhaps that's why it is so versatile, tolerant of many levels of dilution. The numbers below assume you use a lively 15-second stir with 120 grams of ice that is 1¼ inches on a side.

Recipe volume: 3–3¼ ounces (90–97 ml) **Initial alcohol by volume:** 29–43%

Initial sugar and acid content: 5.3–8.0 g/100 ml sugar, 0.15–0.20% acid **Dilution:** 41–49%

Finished drink volume: 4⅓–4¾ ounces (130–142 ml) **Finished alcohol by volume:** 21–29%

Finished sugar and acid content: 3.7–5.6 g/100 ml sugar, 0.10–0.14% acid

SHAKEN DRINKS: Shaken drinks are often sour drinks, containing roughly equal parts simple syrup (or its equivalent) and lime or lemon juice (or its equivalent). Simple syrup contains ten times as much sugar per ounce as lime or lemon juice contains acid per ounce, so most shaken drinks contain about 10 times as much sugar as acid. Finished alcohol levels for shaken drinks float mostly between 15 and 20%. The recipe volumes quoted here are too large to fit in a coupe glass in some cases. Remember that these numbers give you the actual size of the drink you create, not what is poured into the glass. Once you factor in holdback and loss on pouring, the drink in your glass might be a quarter-ounce lower—sometimes more. My assumptions are based on a 10-second shake with 120 grams of 1¼-inch ice cubes.

Recipe volume: 3¼–3¾ ounces (98–112 ml) **Initial alcohol by volume:** 23.0–31.5%

Initial sugar and acid content: 8.0–13.5 g/100 ml sugar, 1.20–1.40% acid **Dilution:** 51–60%

Finished drink volume: 5⅕–5⁹⁄₁₀ ounces (156–178 ml) **Finished alcohol by volume:** 15.0–19.7%

Finished sugar and acid content: 5.0–8.9 g/100 ml sugar, 0.76–0.94% acid

SHAKEN DRINKS WITH EGG WHITE: A typical large egg white is around 1 ounce (30 ml), so drinks shaken with egg white start out an ounce (30 ml) more diluted than their shaken siblings. Because they are more diluted, egg-white drinks often have a higher sugar-to-acid ratio than other shaken drinks, although because the drinks are more diluted, the overall levels of acid and sugar tend to be lower. My assumptions here are a 10-second dry-shake to mix and froth the egg white into the cocktail followed by a 10-second shake with 120 grams of 1¼-inch ice cubes.

Recipe volume: 4⅓–4¾ ounces (130–143 ml) **Initial alcohol by volume:** 18–23%

Initial sugar and acid content: 10.0–13.2 g/100 ml sugar, 0.73–1.00% acid **Dilution:** 46–49%. Notice that these dilution rates are much lower than those of normal shaken drinks because of the lower starting alcohol content.

Finished drink volume: 6⅔–7 ounces (198–209 ml) **Finished alcohol by volume:** 12.1–15.2%

Finished sugar and acid content: 6.7–9.0 g/100 ml sugar, 0.49–0.68% acid **BLENDED DRINKS:** I analyzed the blended drinks from the previous section of this book. Remember, I cheated the laws of dilution slightly by dissolving sugar directly into booze to keep the alcohol level fairly high despite massive dilution. Because blended drinks are very diluted, they have slightly less acid per unit of sugar than you would find in a shaken drink. The volumes given here are for the liquid part of the drink only, not the unmelted ice crystals. They will contain an extra 1½ ounces (45 ml) of unmelted ice crystals when they are poured.

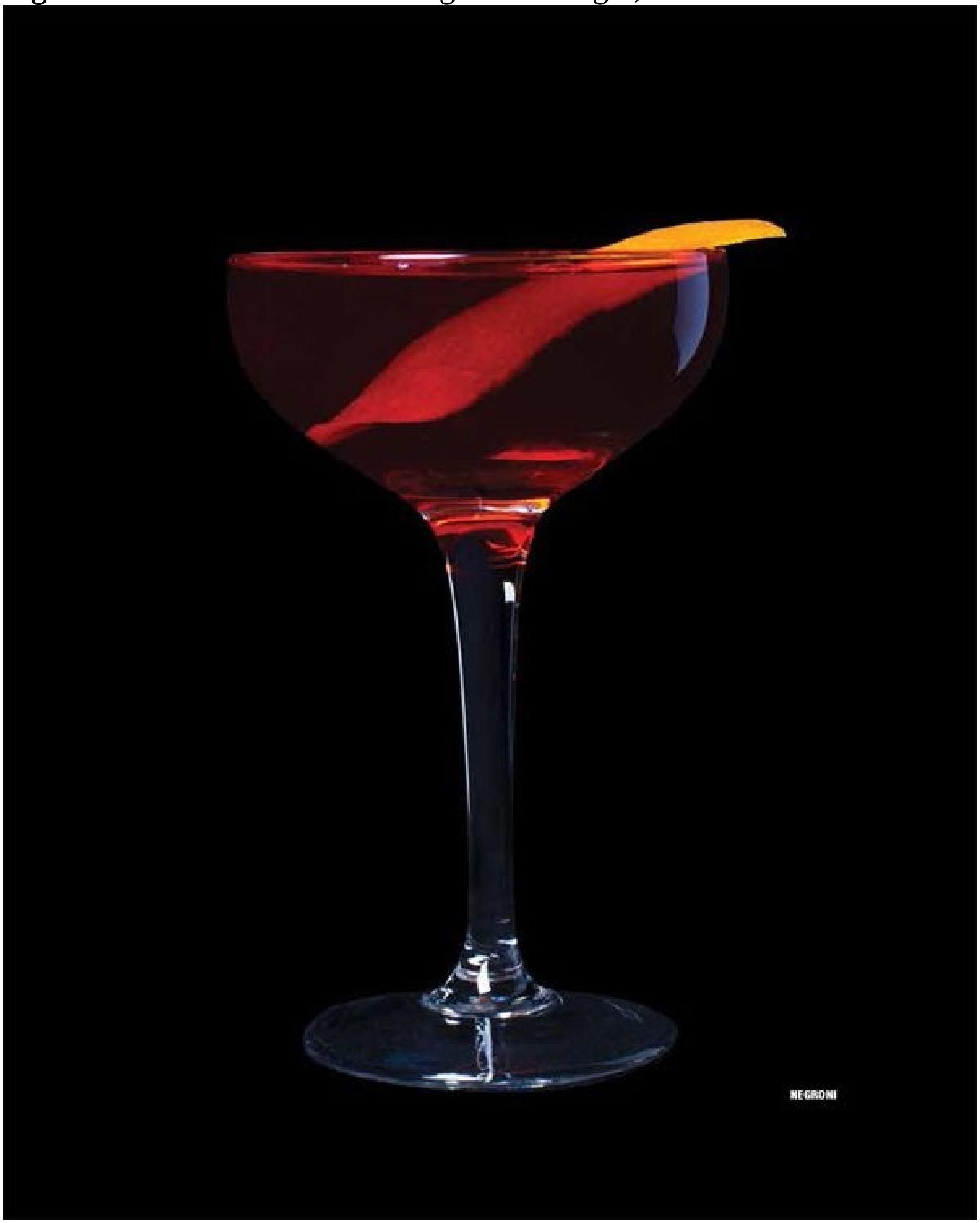
Recipe volume: ¾ ounces (82.5 ml) **Initial alcohol by volume:** 28.6–32.8%

Initial sugar and acid content: 15.0–15.4 g/100 ml sugar, 1.08–1.09% acid **Dilution:** 90%!

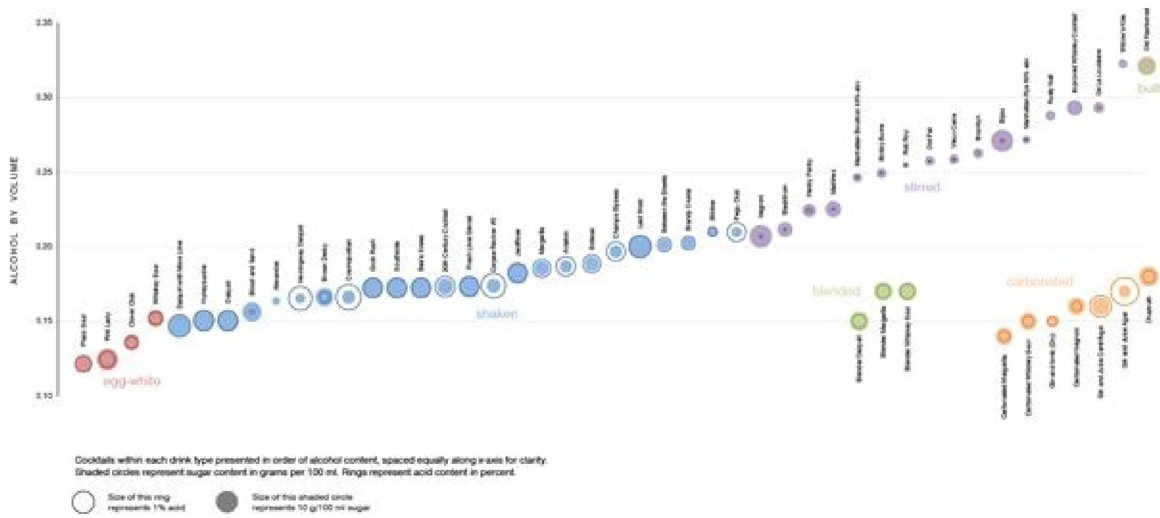
Finished drink volume: 5¼ ounces (157.5 ml) plus an additional 1½ ounces (45 ml) ice crystals **Finished alcohol by volume:** 15.0–17.2%

Finished sugar and acid content: 7.9–8.1 g/100 ml sugar, 0.57% acid **CARBONATED DRINKS:** We haven't discussed carbonation yet, so I'll leave the details for later. I have analyzed seven of my carbonated recipes to give you a cross-section of carbonated drink types. I developed all the higher-alcohol recipes (above 16%) years ago. My newer, more evolved recipes tend to float between 14 and 15%. Carbonated cocktails tend to have slightly lower sugar-to-acid ratios than shaken drinks, much like blender and egg-white drinks. Like other highly diluted drinks, they lower overall sugar and acid content as well. Carbonated drinks are diluted before they are chilled, so you don't have before and after numbers to remember.

Recipe volume: 5 ounces (150 ml) **Alcohol by volume:** 14–16%
Sugar and acid content: 5.0–7.5 g/100 ml sugar, 0.38–0.51% acid



COCKTAIL BALANCE AT A GLANCE



SPECIFICATIONS FOR COCKTAIL BALANCE AT A GLANCE CHART, ABOVE

BUILT

OLD-FASHIONED

Mix volume: 72.6 ml

Finished volume: 90 ml

Start: 39.8% abv, 9.4 g/100 ml sugar, 0% acid

Finish: 32.1% abv, 7.6 g/100 ml sugar, 0% acid

2 oz (60 ml) bourbon (47% abv)

⅜ oz (11 ml) simple syrup

2 dashes Angostura bitters

Build over a large rock in an old-fashioned glass with an orange twist.

STIRRED

WIDOW’S KISS

Mix volume: 76.6 ml

Finished volume: 113.8 ml

Start: 47.9% abv, 5.5 g/100 ml sugar, 0% acid

Finish: 32.3% abv, 3.7 g/100 ml sugar, 0% acid

2 oz (60 ml) apple brandy (50% abv)

$\frac{1}{4}$ oz (7.5 ml) Benedictine $\frac{1}{4}$ oz (7.5 ml) Yellow Chartreuse

2 dashes Angostura bitters

Stir and serve in a coupe glass.

DE LA LOUISIANE
Mix volume: 97.4 ml
Finished volume: 143.6 ml
Start: 43.2% abv, 6.6 g/100 ml sugar, 0.09% acid
Finish: 29.3% abv, 4.5 g/100 ml sugar, 0.06% acid
2 oz (60 ml) rye (50% abv)
$\frac{1}{2}$ oz (15 ml) Benedictine $\frac{1}{2}$ oz (15 ml) sweet vermouth 3 dashes Peychaud's bitters
3 dashes Angostura bitters

3 dashes absinthe

Stir and serve in a coupe glass with a cherry.

IMPROVED WHISKEY COCKTAIL
Mix volume: 76.6 ml
Finished volume: 113 ml
Start: 43.2% abv, 9.5 g/100 ml sugar, 0% acid
Finish: 29.3% abv, 6.5 g/100 ml sugar, 0% acid
2 oz (60 ml) rye (50% abv)
$\frac{1}{4}$ oz (7.5 ml) Luxardo Maraschino $\frac{1}{4}$ oz (7.5 ml) simple syrup

2 dashes Angostura bitters

Stir and serve over a large rock in an absinthe-rinsed old-fashioned glass with a lemon twist.

RUSTY NAIL
Mix volume: 75 ml
Finished volume: 110.4 ml
Start: 42.4% abv, 6 g/100 ml sugar, 0% acid

Start: 42.4% abv, 6 g/100 ml sugar, 0% acid
Finish: 28.8% abv, 4.1 g/100 ml sugar, 0% acid
2 oz (60 ml) Scotch (43% abv)
$^{1}/_{2}$ oz (15 ml) Drambuie Stir and serve over a large rock in an old-fashioned glass with a lemon peel.

MANHATTAN WITH RYE

Mix volume: 88.3 ml
Finished volume: 129.2 ml
Start: 39.8% abv, 4.9 g/100 ml sugar, 0.18% acid
Finish: 27.2% abv, 3.4 g/100 ml sugar, 0.12% acid
2 oz (60 ml) rye (50% abv)
0.875 oz (26.66 ml) sweet vermouth

2 dashes Angostura bitters

Stir and serve in a coupe glass with a cherry or orange twist.

BIJOU

Mix volume: 90.8 ml
Finished volume: 132.9 ml
Start: 39.6% abv, 13.6 g/100 ml sugar, 0.2% acid
Finish: 27.1% abv, 9.3 g/100 ml sugar, 0.14% acid
1 oz (30 ml) gin (47.3% abv)
1 oz (30 ml) sweet vermouth
1 oz (30 ml) Green Chartreuse

1 dash orange bitters

Stir and serve in a coupe glass with a cherry and a twist of lemon.

BROOKLYN

Mix volume: 97.6 ml
Finished volume: 142.3 ml
Start: 38.3% abv, 6.1 g/100 ml sugar, 0.09% acid
Finish: 26.3% abv, 4.2 g/100 ml sugar, 0.06% acid
2 oz (60 ml) rye (50% abv)
$^{1}/_{2}$ oz (15.75 ml) Amer Picon $^{1}/_{2}$ oz (14.25 ml) dry vermouth $^{1}/_{4}$ oz (6.75 ml)

Luxardo Maraschino

1 dash Angostura bitters

Stir and serve in a coupe glass with a cherry.

VIEUX CARRÉ
Mix volume: 91.6 ml
Finished volume: 133.4 ml
Start: 37.6% abv, 5.9 g/100 ml sugar, 0.15% acid
Finish: 25.9% abv, 4.1 g/100 ml sugar, 0.1% acid
1 oz (30 ml) rye (50% abv)
1 oz (30 ml) Cognac (41% abv)
¾ oz (23.25 ml) sweet vermouth ¼ oz (6.75 ml) Benedictine

1 dash Angostura bitters

1 dash Peychaud’s bitters
Stir and serve over a large rock in an old-fashioned glass.

OLD PAL
Mix volume: 105 ml
Finished volume: 152.8 ml
Start: 37.5% abv, 5.8 g/100 ml sugar, 0.13% acid
Finish: 25.7% abv, 4 g/100 ml sugar, 0.09% acid
2 oz (60 ml) rye (50% abv)
¾ oz (22.5 ml) Campari ¾ oz (22.5 ml) dry vermouth Stir and serve in a coupe glass.

ROB ROY
Mix volume: 99.1 ml
Finished volume: 144.1 ml
Start: 37% abv, 3.7 g/100 ml sugar, 0.14% acid
Finish: 25.5% abv, 2.5 g/100 ml sugar, 0.09% acid
2.5 oz (75 ml) Scotch (43% abv)
¾ oz (22.5 ml) sweet vermouth

2 dashes Angostura bitters

2 dashes Angostura bitters

Stir and serve in a coupe glass with a lemon twist.

BOBBY BURNS

Mix volume: 90 ml
Finished volume: 130.4 ml
Start: 36.1% abv, 6 g/100 ml sugar, 0.15% acid
Finish: 24.9% abv, 4.2 g/100 ml sugar, 0.1% acid
2 oz (60 ml) Scotch (43% abv)
$^3/_4$ oz (22.5 ml) sweet vermouth $^1/_4$ oz (7.5 ml) Benedictine Stir and serve in a coupe glass with a lemon twist.

MANHATTAN WITH BOURBON

Mix volume: 91.6 ml
Finished volume: 132.6 ml
Start: 35.7% abv, 5.3 g/100 ml sugar, 0.2% acid
Finish: 24.6% abv, 3.7 g/100 ml sugar, 0.14% acid
2 oz (60 ml) bourbon (45% abv)
1 oz (30 ml) sweet vermouth

2 dashes Angostura bitters

Stir and serve in a coupe glass with a cherry or orange twist.

MARTINEZ

Mix volume: 98.4 ml
Finished volume: 140.8 ml
Start: 32.2% abv, 9.5 g/100 ml sugar, 0.18% acid
Finish: 22.5% abv, 6.6 g/100 ml sugar, 0.13% acid
2 oz (60 ml) Old Tom gin (40% abv)
1 oz (30 ml) sweet vermouth
$^1/_4$ oz (6.75 ml) Luxardo Maraschino 1 dash Angostura bitters

1 dash orange bitters

Stir and serve in a coupe glass with a lemon twist.

HANKY PANKY

Mix volume: 94 ml
Finished volume: 134.4 ml
Start: 32.1% abv, 8 g/100 ml sugar, 0.29% acid
Finish: 22.4% abv, 5.6 g/100 ml sugar, 0.2% acid
1½ oz (45 ml) sweet vermouth 1½ oz (45 ml) gin (47% abv)

1 bar spoon Fernet Branca

Stir and serve in a coupe glass with an orange twist.

BLACKTHORN

Mix volume: 91.6 ml
Finished volume: 130 ml
Start: 30% abv, 8.9 g/100 ml sugar, 0.15% acid
Finish: 21.1% abv, 6.3 g/100 ml sugar, 0.1% acid
1½ oz (45 ml) Plymouth gin ¾ oz (22.5 ml) sweet vermouth ¾ oz (22.5 ml) sloe gin

2 dashes orange bitters

Stir and serve in a coupe glass with an orange twist.

NEGRONI

Mix volume: 90 ml
Finished volume: 127.3 ml
Start: 29.3% abv, 13.3 g/100 ml sugar, 0.2% acid
Finish: 20.7% abv, 9.4 g/100 ml sugar, 0.14% acid
1 oz (30 ml) sweet vermouth
1 oz (30 ml) gin (47.3% abv)
1 oz (30 ml) Campari
Stir and serve in a coupe glass or over a large rock in an old-fashioned glass with a twist of orange or grapefruit.

SHAKEN

PEGU CLUB

Mix volume: 106.6 ml
Finished volume: 172 ml

Finished volume: 172 ml

Start: 33.8% abv, 6.7 g/100 ml sugar, 1.27% acid

Finish: 21% abv, 4.2 g/100 ml sugar, 0.78% acid

2 oz (60 ml) gin (47.3% abv)

3⁄4 oz (22.5 ml) lime juice 3⁄4 oz (22.5 ml) Curaçao 1 dash orange bitters

1 dash Angostura bitters

Shake and serve in a coupe glass with a lime wheel.

BLINKER

Mix volume: 86.5 ml

Finished volume: 140 ml

Start: 34.7% abv, 6.7 g/100 ml sugar, 0.62% acid

Finish: 21.4% abv, 4.1 g/100 ml sugar, 0.39% acid

2 oz (60 ml) rye (50% abv)

3⁄4 oz (22.5 ml) grapefruit juice

1 bar spoon raspberry syrup

Shake and serve in a coupe glass.

BRANDY CRUSTA

Mix volume: 97.5ml

Finished volume: 156.3 ml

Start: 32.5% abv, 7.6 g/100 ml sugar, 0.92% acid

Finish: 20.2% abv, 4.7 g/100 ml sugar, 1/28% acid 2 oz (60 ml) Cognac (41% abv)

1⁄2 oz (15 ml) Curaçao 1⁄2 oz (15 ml) lemon juice 1⁄4 oz (7.5 ml) Luxardo Maraschino Shake and serve in a sugar-rimmed coupe glass with a big lemon spiral.

BETWEEN THE SHEETS

Mix volume: 97.5 ml

Finished volume: 156.2 ml

Start: 32.2% abv, 7.2 g/100 ml sugar, 0.92% acid

Finish: 20.1% abv, 4.5 g/100 ml sugar, 1/28% acid

1 1⁄2 oz (45 ml) Cognac (41% abv) 3⁄4 oz (22.5 ml) Curaçao 1⁄2 oz (15 ml)

white rum (40% abv) 1⁄2 oz (15 ml) lemon juice Shake and serve in a coupe glass with a discarded lemon twist.

LAST WORD

Mix volume: 90.1 ml

Finished volume: 144.2 ml

Start: 32% abv, 15.4 g/100 ml sugar, 1 1/2% acid

Finish: 20% abv, 9.6 g/100 ml sugar, 0.94% acid

3⁄4 oz (22.5 ml) lime juice 3⁄4 oz (22.5 ml) Green Chartreuse 3⁄4 oz (22.5 ml) Luxardo Maraschino 3⁄4 oz (22.5 ml) Plymouth gin

2 drops saline solution

Shake and serve in a coupe glass.

CHAMPS-ÉLYSÉES

Mix volume: 105.8 ml

Finished volume: 168.8 ml

Start: 31.4% abv, 8.3 g/100 ml sugar, 1.28% acid

Finish: 19.7% abv, 5.2 g/100 ml sugar, 0.8% acid

2 oz (60 ml) Cognac (41% abv)

3⁄4 oz (22.5 ml) lemon juice 1⁄2 oz (15 ml) Green Chartreuse 1⁄4 oz (7.5 ml) simple syrup

1 dash Angostura bitters

Shake and serve in a coupe glass with a discarded lemon twist.

SIDECAR

Mix volume: 112.5 ml

Finished volume: 178.2 ml

Start: 29.9% abv, 9.4 g/100 ml sugar, 1.2% acid

Finish: 18.9% abv, 6 g/100 ml sugar, 0.76% acid

2 oz (60 ml) Cognac (41% abv)

3⁄4 oz (22.5 ml) Cointreau 3⁄4 oz (22.5 ml) lemon juice 1⁄4 oz (7.5 ml) simple syrup Shake and serve in a coupe glass with a discarded orange twist.

AVIATION

Mix volume: 105 ml

Finished volume: 166 ml

Start: 29.5% abv, 8 g/100 ml sugar, 1.29% acid

Finish: 18.7% abv, 5.1 g/100 ml sugar, 0.81% acid

2 oz (60 ml) Plymouth gin

¾ oz (22.5 ml) lemon juice ½ oz (15 ml) Luxardo Maraschino ¼ oz (7.5 ml) crème de violette Shake and serve in a coupe glass.

MARGARITA

Mix volume: 112.8 ml

Finished volume: 178ml

Start: 29.3% abv, 9.4 g/100 ml sugar, 1.2% acid

Finish: 18.5% abv, 6 g/100 ml sugar, 0.76% acid

2 oz (60 ml) blanco tequila (40% abv)

¾ oz (22.5 ml) lime juice ¾ oz (22.5 ml) Cointreau ¼ oz (7.5 ml) simple syrup

5 drops saline solution

Shake and serve in a coupe glass (salted rim optional).

JACK ROSE

Mix volume: 105.8 ml

Finished volume: 166.6 ml

Start: 28.7% abv, 13.5 g/100 ml sugar, 1.28% acid

Finish: 18.2% abv, 8.5 g/100 ml sugar, 0.81% acid

2 oz (60 ml) apple brandy (50% abv)

¾ oz (22.5 ml) Grenadine ¾ oz (22.5 ml) lemon juice

1 dash Angostura bitters

Shake and serve in a coupe glass.

CORPSE REVIVER #2

Mix volume: 92.5 ml

Finished volume: 144.3 ml

Start: 27.1% abv, 8.9 g/100 ml sugar, 1.61% acid

Finish: 17.4% abv, 5.7 g/100 ml sugar, 1.03% acid

$^{3}/_{4}$ oz (22.5 ml) lemon juice $^{3}/_{4}$ oz (22.5 ml) gin (47% abv) $^{3}/_{4}$ oz (22.5 ml) Cointreau $^{3}/_{4}$ oz (22.5 ml) Lillet Blanc

3 dashes absinthe or Pernod

Shake and serve in a coupe glass with a discarded orange twist.

FRESH LIME GIMLET

Mix volume: 105 ml

Finished volume: 163.7 ml

Start: 27% abv, 13.5 g/100 ml sugar, 1.29% acid

Finish: 17.3% abv, 8.7 g/100 ml sugar, 0.82% acid

2 oz (60 ml) gin (47.3% abv)

$^{3}/_{4}$ oz (22.5 ml) lime juice $^{3}/_{4}$ oz (22.5 ml) simple syrup Shake and serve in a coupe glass with a lime wheel.

20TH-CENTURY COCKTAIL

Mix volume: 112.5 ml

Finished volume: 175.4 ml

Start: 27% abv, 10.1 g/100 ml sugar, 1.32% acid Finish: 17.3% abv, 6.5 g/100 ml sugar, 0.85% acid

1$^{1}/_{2}$ oz (45 ml) gin (47% abv) $^{3}/_{4}$ oz (22.5 ml) lemon juice $^{3}/_{4}$ oz (22.5 ml) white crème de cacao $^{3}/_{4}$ oz (22.5 ml) Lillet Blanc Shake and serve in a coupe glass.

BEE'S KNEES

Mix volume: 105 ml

Finished volume: 163.6 ml

Start: 26.9% abv, 13.5 g/100 ml sugar, 1.29% acid

Finish: 17.2% abv, 8.7 g/100 ml sugar, 0.83% acid

2 oz (60 ml) gin (47% abv)

$^{3}/_{4}$ oz (22.5 ml) honey syrup $^{3}/_{4}$ oz (22.5 ml) lemon juice Shake and serve in a coupe glass with a lemon wheel.

SOUTHSIDE

Mix volume: 105 ml

Finished volume: 163.6 ml

Start: 26.9% abv, 13.5 g/100 ml sugar, 1.29% acid

Finish: 17.2% abv, 8.7 g/100 ml sugar, 0.83% acid

2 oz (60 ml) gin (47% abv)

$^3/_4$ oz (22.5 ml) lemon juice $^3/_4$ oz (22.5 ml) simple syrup Shake with a handful of mint leaves and serve in a coupe glass with mint.

GOLD RUSH

Mix volume: 105 ml

Finished volume: 163.6 ml

Start: 26.9% abv, 13.5 g/100 ml sugar, 1.29% acid

Finish: 17.2% abv, 8.7 g/100 ml sugar, 0.83% acid

2 oz (60 ml) bourbon (47% abv)

$^3/_4$ oz (22.5 ml) lemon juice $^3/_4$ oz (22.5 ml) honey syrup Shake and serve over a large rock in an old-fashioned glass.

COSMOPOLITAN

Mix volume: 105 ml

Finished volume: 162.5 ml

Start: 25.7% abv, 8.4 g/100 ml sugar, 1.63% acid

Finish: 16.6% abv, 5.5 g/100 ml sugar, 1.05% acid

1$^1/_2$ oz (45 ml) Absolut Citron vodka $^3/_4$ oz (22.5 ml) Cointreau $^3/_4$ oz (22.5 ml) cranberry juice $^1/_2$ oz (15 ml) lime juice Shake and serve in a coupe glass with a discarded (optionally flamed) orange twist.

Note: The fellow who came up with the Cosmo, Toby Cecchini, told me that the recipe above is a bastardized farce. He says the actual recipe is this even more acidic version: COSMOPOLITAN TC (NOT CHARTED)

Mix volume: 139 ml

Finished volume: 215 ml

Start: 25.9% abv, 7.2 g/100 ml sugar, 1.85% acid

Finish: 16.7% abv, 4.7 g/100 ml sugar, 1.19% acid

2 oz (60 ml) Absolut Citron vodka

1 oz (30 ml) Cointreau

$^3/_4$ oz (22.5 ml) lime juice $^1/_2$ oz (15 ml) cranberry juice Shake and serve in a coupe glass with an orange twist.

BROWN DERBY

Mix volume: 105 ml

Finished volume: 162.5 ml

Start: 25.7% abv, 11.8 g/100 ml sugar, 0.69% acid

Finish: 16.6% abv, 7.6 g/100 ml sugar, 0.44% acid

2 oz (60 ml) bourbon (45% abv)

1 oz (30 ml) grapefruit juice

½ oz (15 ml) honey syrup Shake and serve in a coupe glass with a discarded grapefruit twist.

HEMINGWAY DAIQUIRI

Mix volume: 112.6 ml

Finished volume: 174.1 ml

Start: 25.6% abv, 6.4 g/100 ml sugar, 1 1/22% acid

Finish: 16.5% abv, 4.1 g/100 ml sugar, 0.98% acid

2 oz (60 ml) white rum (40% abv)

¾ oz (22.5 ml) lime juice ½ oz (15 ml) grapefruit juice ½ oz (15 ml) Luxardo Maraschino

2 drops saline solution

Shake and serve in a coupe glass with a lime wheel.

ALEXANDER

Mix volume: 97.5 ml

Finished volume: 150.4 ml

Start: 25.2% abv, 4.7 g/100 ml sugar, 0% acid

Finish: 16.4% abv, 3.1 g/100 ml sugar, 0% acid

2 oz (60 ml) Cognac (41% abv)

1 oz (30 ml) heavy cream

¼ oz (7.5 ml) Demerara syrup Shake and serve in a coupe glass with grated nutmeg.

BLOOD AND SAND

Mix volume: 90 ml

Finished volume: 137.7 ml

Start: 23.9% abv, 12.3 g/100 ml sugar, 0.28% acid

Finish: 15.6% abv, 8 g/100 ml sugar, 0.19% acid

1 oz (30 ml) Scotch (43% abv)

¾ oz (22.5 ml) Cherry Heering ¾ oz (22.5 ml) sweet vermouth ½ oz (15 ml) orange juice Shake and serve in a coupe glass with an (optionally flamed) orange twist.

CLASSIC DAIQUIRI **Mix volume: 105 ml**

Finished volume: 159.5 ml

Start: 22.9% abv, 13.5 g/100 ml sugar, 1.29% acid

Finish: 15% abv, 8.9 g/100 ml sugar, 0.85% acid

Finish: 15% abv, 8.9 g/100 ml sugar, 0.85% acid

2 oz (60 ml) white rum (40% abv)

¾ oz (22.5 ml) lime juice ¾ oz (22.5 ml) simple syrup Shake and serve in a coupe glass.

HONEYSUCKLE

Mix volume: 105 ml

Finished volume: 159.5 ml

Start: 22.9% abv, 13.5 g/100 ml sugar, 1.29% acid

Finish: 15% abv, 8.9 g/100 ml sugar, 0.85% acid

2 oz (60 ml) white rum (40% abv)

¾ oz (22.5 ml) lime juice ¾ oz (22.5 ml) honey syrup Shake and serve in a coupe glass with a lime wheel.

DAIQUIRI (MORE LIME)

Mix volume: 108 ml

Finished volume: 163.4 ml

Start: 22.2% abv, 13.2 g/100 ml sugar, 1.42% acid

Finish: 14.7% abv, 8.7 g/100 ml sugar, 0.94% acid

2 oz (60 ml) white rum (40% abv)

0.875 oz (25.5 ml) lime juice

¾ oz (22.5 ml) simple syrup Shake and serve in a coupe glass.

EGG WHITE

WHISKEY SOUR

Mix volume: 130.1 ml

Finished volume: 197.9 ml

Start: 23.1% abv, 10.9 g/100 ml sugar, 0.81% acid

Finish: 15.2% abv, 7.1 g/100 ml sugar, 1/23% acid

2 oz (60 ml) rye (50% abv)

¾ oz (22.5 ml) simple syrup 0.625 oz (17.5 ml) lemon juice

2 drops saline solution

1 oz (30 ml) egg white

Shake without ice to mix and foam egg white, then shake with ice and serve in a coupe glass.

CLOVER CLUB

Mix volume: 135 ml

Mix volume: 135 ml

Finished volume: 201.4 ml

Start: 20.3% abv, 10 g/100 ml sugar, 0.73% acid

Finish: 13.6% abv, 6.7 g/100 ml sugar, 0.49% acid

2 oz (60 ml) Plymouth gin

1 oz (30 ml) egg white

½ oz (15 ml) Dolin dry vermouth ½ oz (15 ml) raspberry syrup ½ oz (15 ml) lemon juice 1 oz (30 ml) egg white

Shake without ice to mix and foam egg white, then shake with ice and serve in a coupe glass. Garnish with a raspberry.

PINK LADY

Mix volume: 142.5 ml

Finished volume: 209.4 ml

Start: 18.3% abv, 13.2 g/100 ml sugar, 0.95% acid

Finish: 12.4% abv, 9 g/100 ml sugar, 0.64% acid

1½ oz (45 ml) Plymouth gin 1 oz (30 ml) egg white

¾ oz (22.5 ml) lemon juice ½ oz (15 ml) Grenadine ½ oz (15 ml) simple syrup ½ oz (15 ml) Lairds Applejack Bottled in Bond Shake without ice to mix and foam egg white, then shake with ice and serve in a coupe glass.

PISCO SOUR

Mix volume: 135 ml

Finished volume: 197.5 ml

Start: 17.8% abv, 11/2 g/100 ml sugar, 1% acid

Finish: 12.1% abv, 7.2 g/100 ml sugar, 0.68% acid

2 oz (60 ml) pisco (40% abv)

1 oz (30 ml) egg white

¾ oz (22.5 ml) lime juice ¾ oz (22.5 ml) simple syrup Shake without ice to mix and foam egg white, then shake with ice and serve in a coupe glass topped with 3 drops Angostura bitters or Amargo Chuncho.

BLENDED

BLENDER WHISKEY SOUR

Mix volume: 157.7 ml

Finished volume: 157.7 ml

Start: 16.7% abv, 7.8 g/100 ml sugar, 0.61% acid

Finish: 16.7% abv, 7.8 g/100 ml sugar, 0.61% acid

2½ oz (75 ml) water
2 oz (60 ml) sugared 100-proof rye (44% abv)
½ oz (15 ml) lemon juice ¼ oz (7.5 ml) orange juice

4 drops saline solution

Blend with 120 grams ice, strain out large chunks, and serve in a coupe glass.

BLENDER MARGARITA
Mix volume: 158 ml
Finished volume: 158 ml
Start: 17.2% abv, 7.9 g/100 ml sugar, 1.27% acid
Finish: 17.2% abv, 7.9 g/100 ml sugar, 1.27% acid
2½ oz (75 ml) water
1 oz (30 ml) Cointreau
¾ oz (22.5 ml) white mezcal (40% abv) ½ oz (15 ml) Yellow Chartreuse ½ oz (15 ml) lime juice

10 drops Hellfire bitters

Blend with 120 grams ice, strain out large chunks, and serve in a coupe glass.

BLENDER DAIQUIRI **Mix volume: 157.7 ml**
Finished volume: 157.7 ml
Start: 15% abv, 8.1 g/100 ml sugar, 1.27% acid
Finish: 15% abv, 8.1 g/100 ml sugar, 1.27% acid
2½ oz (75 ml) water
2¼ oz (67.5 ml) sugared 80-proof rum (35% abv)
½ oz (15 ml) lime juice

4 drops saline solution

Blend with 120 grams ice, strain out large chunks, and serve in a coupe glass.

CARBONATED

CHARTRUTH

Mix volume: 165 ml

Finished volume: 165 ml

Start: 18% abv, 8.3 g/100 ml sugar, 1.21% acid

Finish: 18% abv, 8.3 g/100 ml sugar, 1.21% acid

3¼ oz (97 ml) water 1¾ oz (54 ml) Green Chartreuse ½ oz (14 ml) clarified lime juice Chill and carbonate.

GIN AND JUICE, AGAR CLARIFIED

Mix volume: 165.1 ml

Finished volume: 165.1 ml

Start: 16.9% abv, 5 g/100 ml sugar, 1.16% acid

Finish: 16.9% abv, 5 g/100 ml sugar, 1.16% acid

2⅝ oz (80 ml) agar-clarified grapefruit juice 2 oz (59 ml) gin (47.3% abv)

⅞ oz (26 ml) water

2 drops saline solution

Chill and carbonate.

GIN AND JUICE, CENTRIFUGE CLARIFIED

Mix volume: 165 ml

Finished volume: 165 ml

Start: 15.8% abv, 7.2 g/100 ml sugar, 0.91% acid

Finish: 15.8% abv, 7.2 g/100 ml sugar, 0.91% acid

1⅞ oz (55 ml) gin (47.3% abv) 1⅞ oz (55 ml) centrifuge-clarified grapefruit juice 1⅜ oz (42 ml) water ⅜ oz (10 ml) simple syrup

4 dashes champagne acid

Chill and carbonate.

CARBONATED NEGRONI

Mix volume: 165.1 ml

Finished volume: 165.1 ml

Start: 16% abv, 7.3 g/100 ml sugar, 0.38% acid

Finish: 16% abv, 7.3 g/100 ml sugar, 0.38% acid

$2\frac{1}{4}$ oz (67.5 ml) water 1 oz (30 ml) sweet vermouth
1 oz (30 ml) gin (47.3% abv)
1 oz (30 ml) Campari
$\frac{1}{4}$ oz (7.5 ml) clarified lime juice or champagne acid

2 drops saline solution

Chill and carbonate. Serve with a discarded grapefruit twist.

GIN AND TONIC (DRY)
Mix volume: 164.6 ml
Finished volume: 164.6 ml
Start: 15.4% abv, 4.9 g/100 ml sugar, 0.41% acid
Finish: 15.4% abv, 4.9 g/100 ml sugar, 0.41% acid
$\frac{7}{8}$ oz (87 ml) water $1\frac{3}{4}$ oz (53.5 ml) gin (47.3% abv) $\frac{3}{8}$ oz (12.8 ml) Quinine Simple Syrup $\frac{3}{8}$ oz (11 1/4 ml) clarified lime juice

2 drops saline solution

Chill and carbonate.

CARBONATED WHISKEY SOUR
Mix volume: 162 ml
Finished volume: 162 ml
Start: 15.2% abv, 7.2 g/100 ml sugar, 0.44% acid
Finish: 15.2% abv, 7.2 g/100 ml sugar, 0.44% acid
$\frac{5}{8}$ oz (78.75 ml) water $1\frac{3}{4}$ oz (52.5 ml) bourbon (47% abv) $\frac{5}{8}$ oz (18.75 ml) simple syrup $\frac{3}{8}$ oz (12 ml) clarified lemon juice

2 drops saline solution

Chill and carbonate.

CARBONATED MARGARITA
Mix volume: 165.2 ml
Finished volume: 165.2 ml
Start: 14.3% abv, 7.1 g/100 ml sugar, 0.44% acid

Start: 14.2% abv, 7.1 g/100 ml sugar, 0.44% acid
Finish: 14.2% abv, 7.1 g/100 ml sugar, 0.44% acid
2½ oz (76 ml) water
2 oz (58.5 ml) blanco tequila (40% abv)
⅝ oz (18.75 ml) simple syrup ⅜ oz (12 ml) clarified lime juice

4 drops saline solution

Chill and carbonate.

COCKTAIL INGREDIENT PERCENTAGES

NOTE: The alcohol levels that I have listed for commercial spirits are accurate. Because it is difficult to measure the sugar levels in any liquor that contains both sugar and alcohol (like Chartreuse), I have relied on published sources and educated guesses to provide sugar levels. The figures for acid in wine-based liqueurs are likewise educated approximations. My fruit-juice sugar and acid levels are averages supplied by the U.S. government and by commercial growers for standard single-strength (as opposed to concentrated) juices; for the Wickson apple I used my own refractometer measurements. Of course, the sugar and acidity of fruits will vary wildly. The alcohol levels of modified spirits are as close as I could estimate.

No straight spirits are included in this list. Their alcohol levels are listed on the bottles, and they typically contain no sugar and minimal titratable acid, even when aged in oak.

TYPE	INGREDIENT	ETHANOL	SWEETNESS	TITRATABLE ACID
Vermouths	Carpano Antica Formula	16.5%	16.0%	0.60%
	Dolin Blanc	16.0%	13.0%	0.60%
	Dolin Dry	17.5%	3.0%	0.60%
	Dolin Rouge	16.0%	13.0%	0.60%
	Generic dry vermouth	17.5%	3.0%	0.60%
	Generic sweet vermouth	16.5%	16.0%	0.60%
	Lillet Blanc	17.0%	9.5%	0.60%
	Martinelli	16.0%	16.0%	0.60%
Liqueurs	Amaro CioCiaro	30.0%	16.0%	0.00%
	Amer Picon	15.0%	20.0%	0.00%
	Aperol	11.0%	24.0%	0.00%
	Benedictine	40.0%	24.5%	0.00%
	Campari	24.0%	24.0%	0.00%
	Chartreuse, Green	55.0%	25.0%	0.00%
	Chartreuse, Yellow	40.0%	31.2%	0.00%
	Cointreau	40.0%	25.0%	0.00%
	Crème de cacao, white	24.0%	39.5%	0.00%
	Crème de violette	20.0%	37.5%	0.00%
	Drambuie	40.0%	30.0%	0.00%
	Fernet Branca	39.0%	8.0%	0.00%
	Luxardo Maraschino	32.0%	35.0%	0.00%
Bitters	Angostura	44.7%	4.2%	0.00%
	Peychauds	35.0%	5.0%	0.00%
Juices	Ashmead's Kernel apple	0.0%	14.7%	1.25%
	Concord grape	0.0%	18.0%	0.50%
	Cranberry	0.0%	13.3%	3.60%
	Granny Smith apple	0.0%	13.0	0.93%
	Grapefruit	0.0%	10.4%	2.40%
	Honeycrisp apple	0.0%	13.8%	0.66%
	Orange	0.0%	12.4%	0.80%
	Strawberry	0.0%	8.%	1.50%
	Wickson apple	0.0%	14.7%	1.25%
Acids	Champagne acid	0.0%	0.0%	6.00%
	Lemon juice	0.0%	1.6%	6.00%
	Lime acid orange	0.0%	0.0%	6.00%
	Lime juice	0.0%	1.6%	6.00%
	Orange juice, lime strength	0.0%	12.4%	6.00%
Sweeteners	70 Brix caramel syrup (sweetness is low because of sugar breakdown during caramelization—a guess)	0.0%	61.5%	0.00%
	Butter syrup	0.0%	42.1%	0.00%
	Coriander syrup	0.0%	61.5%	0.00%
	Demerara syrup	0.0%	61.5%	0.00%
	Djer syrup	0.0%	61.5%	0.00%
	Honey syrup	0.0%	61.5%	0.00%
	Maple syrup	0.0%	87.5%	0.00%
	Any nut orgeat	0.0%	61.5%	0.00%
	Commercial orgeat	0.0%	85.5%	0.00%
	Quinine simple syrup	0.0%	61.5%	0.00%
	Simple syrup	0.0%	61.5%	0.00%
Others	Cabernet sauvignon	14.5%	0.2%	0.55%
	Coconut water	0.0%	6.0%	0.00%
	Espresso	0.0%	0.0%	1.50%
	Sour orange juice	0.0%	12.3%	4.50%
Modified spirits	Café Zacapa	31.0%	0.0%	0.75%
	Chocolate Vodka	40.0%	0.0%	0.00%
	Jalapeño Tequila	40.0%	0.0%	0.00%
	Lemongrass Vodka	40.0%	0.0%	0.00%
	Milk-Washed Rum	34.0%	0.0%	0.00%
	Peanut Butter and Jelly Vodka	32.5%	16.5%	0.25%
	Sugared 100 proof	44.0%	18.5%	0.00%
	Sugared 80 proof	35.0%	18.5%	0.00%
	Tea Vodka	34.0%	0.0%	0.00%
	Turmeric Gin	41.2%	0.0%	0.00%

PART 3

New TECHNIQUES *and* IDEAS

Clarification

Definition, History, Technique

WHAT IS CLARIFICATION?

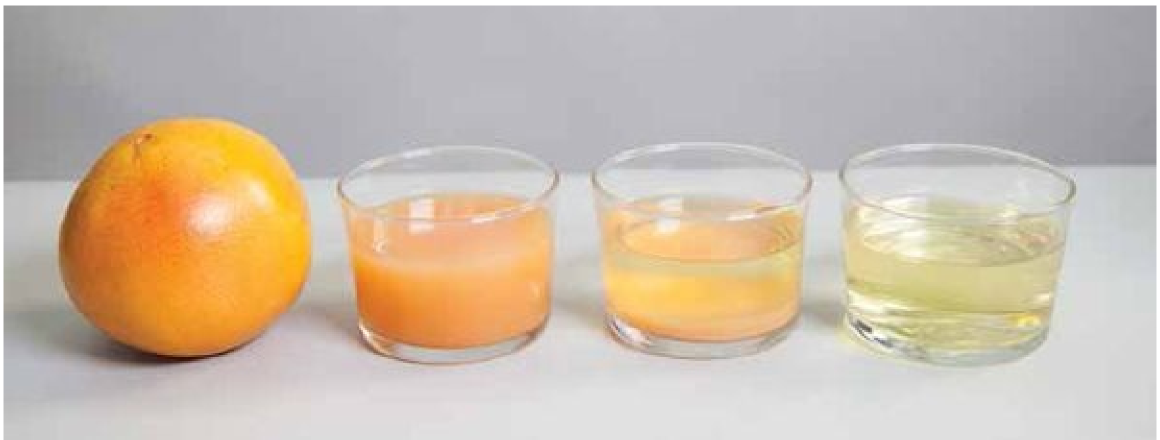
Liquids can be crystal clear, completely opaque, or somewhere in between. Clear doesn't mean colorless. A glass of red wine can be both deeply colored, thanks to the pigments dissolved in it, and clear. Unclear liquids are actually suspensions, containing particles that reflect and scatter light in a random pattern that makes the liquid appear milky. Clarification removes these particles. It pays to remember the difference between dissolved substances, which don't cloud a liquid but may add color, and suspended particles, which are not truly dissolved and scatter light.

It takes a ridiculously small percentage of suspended crud—way less than 1 percent—to make a liquid cloudy. Good clarification gets rid of all, not most, of the light-scattering doodads.

From berry to clear juice.

WHY CLARIFY?

Why clarify? Why breathe? I love the look of crystal-clear liquids. I much prefer a beautiful limpid drink to a murky one. (Remember, clear doesn't mean colorless—think brown liquors.) But clarification's not just about looks: it is also necessary for good carbonation. Particles floating around in your drink provide places for errant bubbles to form. Those errant bubble-making particles will wreak foaming havoc in your drink and reduce the level of carbonation you can achieve. When you squeeze a lime into a gin and tonic, you witness immediate frothing and bubbling. Unacceptable!



One path to clear grapefruit juice.

Clarification also alters the texture of drinks by removing solids and reducing body. Mouth feel is an aspect of cocktails that is often overlooked. I don't want to chew on my drinks, so I almost never use purees without clarifying them first. (I like a traditional bloody Mary, but that's about it.)

I first started worrying about clarification in 2005, when I was obsessing over making the absolute best lime juice for gin and tonics. I didn't know it at the time, but I couldn't have chosen a more difficult clarifying problem. You need to clarify lime juice quickly because lime juice doesn't last, but many clarification techniques take time. You can't use too much heat because heat ruins the flavor of lime, but most clarification uses heat. The particles in lime juice are very small, and small particles are hard to filter. Lime juice is very acidic, and acidity thwarts some clarification tricks.

Turns out that if you can clarify lime juice, you can clarify almost everything else. My lime-juice-clarification efforts eventually unlocked the gin and tonic I sought, and a whole lot more. The journey included messing with filtration, setting gels, using equipment such as centrifuges, and searching out ingredients such as enzymes and wine-fining agents. These days I can—and do—clarify almost everything. It is a bit of a sickness.

CLARIFICATION TECHNIQUES: THE THEORY

Clarification is all about removing suspended particles, separating clear liquids from cloudy solids. It is mainly mechanical in nature. There are three primary means. Filtration blocks particles, allowing clear liquid to run through. In gelation, you trap particles in a gel and coax out the clear liquid. And with separation by density, you assist or augment gravity to allow particles to settle out of the liquid.

First, some theory and history. If you truly have no patience for learning, skip to the clarification flowcharts here for the how-to's.

FILTER CLARIFICATION

Up-front confession: I hate filtration as a clarification technique. Industrially, filtration works great. In your kitchen, not so much. Clarification requires filters much finer than the ones you use for coffee, and they clog frustratingly fast. Sure, filter aids and multiple filter setups can help solve these clogging problems, and you can purchase special charged filters that clog less, but let me reiterate: filter clarification is a drag.

GEL CLARIFICATION

Gel clarification works really well. Simply put, you trap your liquid in a gel and then induce it to leak. This process is called syneresis. The particles that were making your liquid cloudy remain trapped in the gel, and the stuff that leaks out is clear. The gel acts like a massive 3-D filter that never clogs. Gel clarification doesn't require expensive equipment and can be scaled for large quantities.

There are several different ways to clarify with gels.

Old-School Gels: Egg whites and lean ground meat are the original gel-based clarifiers, traditionally used to clarify stocks into consommés. The proteins coagulate and form a gel-like raft through which you continuously ladle your simmering stock. Eventually this raft traps all the cloudy bits and leaves you with a perfectly clarified consommé. This process has many drawbacks for cocktail clarification. It is tedious and prone to error, requires prolonged heating (which can change or destroy delicate flavors), and adds meat flavors where you probably don't want them.

Freeze-Thaw Gelatin: A little over a decade ago, some European chefs, most notably Heston Blumenthal, noticed that when meat stocks containing gelatin were frozen solid and then allowed to thaw in the refrigerator, a raft of gelatin goo held on to cloudy particles and the liquid that dripped out was clear. Freeze-thaw clarification was born. In the early years of the century, on this side of the pond, New York chef Wylie Dufresne realized that this technique isn't limited to stock—you can add gelatin to almost anything, and then freeze and thaw it to get a clear liquid. This observation revolutionized the clarification world. Soon I was freeze-thaw clarifying anything I could get my hands on.

I soon discovered the major drawbacks of freeze-thaw gelatin clarification. It's a bit of a chore, and it ain't quick. You have to freeze your gelatin mixture solid—I mean solid. That takes a day. You must then slowly thaw this frozen block in the fridge, which can take another two days. If you try to cheat and thaw on the counter, the fragile gelatin raft (the thing that's holding back all the cloudy nastiness) will break, and it's all over. Also, you can't start using the stuff that drips out first while you are waiting for the rest to thaw, because the clarified liquid at the beginning is too concentrated and the stuff at the end tastes like water.

Why is this process so finicky? With freeze-thaw gelatin clarification, you use 5 grams of gelatin per liter. A 5-gram-per-liter gelatin mixture is, disconcertingly, still a liquid, not a gel like Jell-O. As the gelatin mixture freezes, the pure water starts to freeze first, and everything else—the gelatin and any color, flavor, sugar, acid, what have you—becomes more and more concentrated as the water continues to freeze. Eventually this solution concentrates enough to form a delicate gel network, the source of the raft. Then that network freezes solid as well. As the gelatin network freezes, it gets torn apart by ice crystals. As it thaws, that torn network retains just enough structure to hold back solids in a sludgelike mass but to leak clear liquid like a sieve.

If everything goes according to plan, this system works great, but because your mix is a liquid at the beginning, it's hard to tell if you've achieved the right consistency before you freeze. You'd like to make a firm gel to increase your peace of mind, but you can't. If your mix were more solid from the get-go—say the consistency of Jell-O, which is self-supporting and rigid at 14 grams of gelatin per liter—it *would* be easier to work with, but the network would not break down enough during the thaw, the gel raft would remain too solid, and the dripping clear liquid that is the point of all this hassle would never materialize.

FREEZE-THAW CLARIFICATION: *The frozen grapefruit juice block at the top left thaws to the nasty looking raft at the bottom. What drips out is the beautifully clear juice at right.*

The upshot is, you never know if everything went right until it is too late. You must wait three days to verify whether your labors yielded a lovely clear liquid or a soupy mess. There has to be a better way.

Freeze-Thaw Agar: I don’t know who first started using agar instead of gelatin for freeze-thaw clarification, but what an awesome idea. Agar is a seaweed-based gelling agent, so, unlike gelatin, it is vegetarian-friendly. Agar gels are very porous—much more so than gelatin—so they leak much more, allowing you to form self-supporting gels and still clarify. Because a real gel is formed *before* the freeze-thaw process begins, you have visual and tactile verification that your clarification will work—a win over gelatin. Because the agar forms a gel, any unfrozen part won’t cloud your product even if you don’t freeze the gel thoroughly—another win. Agar rafts don’t melt until they get very hot, so you can thaw an agar raft much faster than a gelatin raft—major win. One more agar win: it produces, in my estimation, a more sparklingly clear product than gelatin does.

*In freeze-thaw clarification the stuff that drips out at the beginning of the thaw **(left)** is more concentrated in flavor and color than the stuff that drips out at the end **(right)**.*

Agar has only one disadvantage compared with gelatin. Gelatin will dissolve into a liquid with only a modicum of heat, while agar must be boiled and held there for several minutes to fully incorporate, which is too much heat for many delicate products. There is a fix; see the flowchart here.

What would be better than agar clarification is something faster. Even though you can freeze-thaw agar faster than you can freeze and thaw gelatin, the process still takes a couple of days. That's okay for some things, like strawberry juice, but unacceptable for lime juice, which you must use the day you make it.

Also, in any freeze-thaw clarification, what drips out changes over time. The first stuff to thaw is the last stuff that froze: sugars, acids, and other concentrated flavors. As the thawing progresses, the stuff dripping out has less and less flavor. You need to batch all the drippings over the entire process or your flavor will be unbalanced.

For years this problem of slow and uneven processing stuck in my craw. The solution ended up being very simple.

Quick Agar Clarification: In 2009 I discovered that I could clarify with agar simply by breaking the gel with a whisk to increase the surface area and letting it leak. Remember, agar gels are very porous—they want to leak. You have to work hard to get them *not* to leak. So it turned out that freeze-thaw is unnecessary. Extra equipment is unnecessary. Because there is no freeze-thaw cycle, the first drop of juice you get with this technique tastes the same as the last. Also, because there is no freezing, you can clarify otherwise unfreezable *booze* this way (remember to hydrate the agar in water first; booze can’t get hot enough). With quick agar clarification, anyone can clarify anything in under an hour, including—finally!—lime juice.

Quick agar isn’t perfect. A bit of skill is involved, and it takes a while to get the knack. You will see in the how-to flowchart that lots of messy hand-straining through cloth is called for, so quick agar is inconvenient for large quantities. It is rarely as perfect as freeze-thaw; some agar usually gets into the final product and can form visible wisps if left to sit overnight. For all these faults, however, quick agar remains my go-to technique when I have to clarify away from my centrifuge.

WHEN TO USE GELATIN FREEZE-THAW

When making a drink with meat stock, like a bullshot, always use gelatin freeze-thaw clarification, and not just because it makes sense to use the gelatin already present in the stock. With any other clarification method, the stock gelatin remains, and when you reduce the stock to condense the flavors, which you always do for cocktails (I reduce by a factor of 4 or more), it will get gluey and unusable. With gelatin freeze-thaw, you remove the gelatin from the stock as you clarify, so your stock can be reduced a ridiculous amount and still end up thin and limpid, even when cocktail-cold.

Trick: you’ll probably need to add a little water to your stock before you free-thaw clarify. Most stocks have too much gelatin in them to freeze-thaw clarify effectively. At most, you want a stock that just barely gels when cold. Even better is a stock that just barely doesn’t gel. After your clear consommé drips out, you can reduce out all the extra water.

For a nice savory shot I like concentrated gelatin-free consommé, centrifuge-clarified tomato water, iSi rapid-infused jalapeño tequila, a pickled cherry tomato, and a healthy dose of salt.

GEL CLARIFICATION RECAP

Freeze-thaw agar has some advantages over quick agar clarification: it entails less labor, is more foolproof, and produces a product that will never recloud. But remember, you’ll need a lot of freezer space to make large quantities, and the technique takes a couple of days. Quick agar works great for small quantities of products that you want to clarify quickly and use the same day.

The main disadvantage of all gel clarifications is the yield: you will always lose some liquid in the gel raft that remains after clarification. Expect to sacrifice at least a quarter of your product, sometimes more.

GRAVITATIONAL CLARIFICATION: RACKING, CENTRIFUGING, FINING

Most of the time, suspended particles are denser than the liquid they are floating in. If unhindered, they will eventually fall to the bottom of the liquid. This behavior is the basis of separation based on density.

RACKING

In a liquid in which the particles are large and relatively free to move around, you can employ the simplest density-separation technique, racking. Just put the liquid in a container and let it settle over time. After all the particles settle to the bottom, decant the clear liquid off the top, and you are done.

You can't use racking alone very often in practice because many liquids settle very slowly, and some will never settle at all—at least, not in your lifetime. Sometimes settling won't occur because particles are too small, sometimes because their movement is blocked by stabilizers in the liquid. Even in liquids that settle fairly quickly, such as carrot juice, racking can be difficult because the particles don't form a compact layer at the bottom; they float around near the bottom instead. That floaty zone contains a lot of juice you won't be able to clarify, so your yield will be lousy. If you are going to clarify by racking, make sure to use round containers. Liquids moving in square containers kick up small particles and ruin the clarification.

CENTRIFUGING

To get around the problems with racking, I use a centrifuge. Centrifuges spin fluids rapidly. Anything inside the centrifuge tends to get pushed toward the outside—that's centrifugal force. Centrifuges are rated by how much force they produce relative to the force of gravity, and they can produce many thousands of times the force of gravity. They radically exaggerate the difference in density between a liquid and the particles floating in it, and drastically increase the speed at which particles settle out of a liquid. The force also tends to smash those particles into a firm cake, called a puck, so your yield is high. Sweet.

A tube from the under-200 dollar centrifuge filled with crabapple juice that was treated with Pectinex Ultra SP-L. The solids are smashed into the bottom and sides of the tube. The compressed solids in a centifuge bucket, which you'll find in larger centrifuges, are called a puck, but in a tube they're referred to as a pellet. It's easy to rack the clear liquid off the top.

The Problem with Centrifuges: As I write, centrifuges are still esoteric, but that is changing. In 2013, a centrifuge that could handle enough product for a busy bar (3 liters) cost $8000 and was the size of two microwaves. A small unit to play with at home is the size of a toaster and costs a couple hundred bucks. (It works but holds a tiny amount of product and is therefore basically a toy.) I predict an explosion of centrifuges in the next ten years. Many more people will have them, and a centrifuge the size of a microwave with enough capacity for a professional will cost less than $1000. Centrifuges are the wave of the juice future.

When I first started using centrifuges, in 2008, I was borrowing time on a superspeed centrifuge at my buddy Professor Kent Kirshenbaum's NYU lab. It could spin 500 milliliters of juice at 48,000 times the force of gravity! As you know, I was interested in the holy grail of clarification: lime juice. I hadn't yet figured out quick agar. I learned some fascinating but depressing things on that centrifuge. Lime juice doesn't start clarifying until your centrifuge gets to about 27,000 g's. A centrifuge that can pull 27,000 g's is larger, more expensive, and more dangerous than any centrifuge I'd care to have at a bar. Even worse, 27,000-g lime juice tastes metallic. At 48,000 g's, lime juice tastes great, but a centrifuge that can do 48,000 g's is even less practical for your bar—tens of thousands of dollars and the size of a washing machine.

I tried clarifying other juices as well: ginger, grapefruit, apple. Not all of them required the full 48,000 g’s, but most juices and purees needed more than a reasonable centrifuge could muster. Practical bar/restaurant centrifuges max out at about 4000 g’s. I needed to find a way to get the results I wanted with a fairly puny ʼfuge. And I did. Here’s how.

Refining the Process: In the cocktail world we mostly clarify purees and juices from fruits and vegetables. These purees and juices all have suspended chunks of cells and cell walls composed largely of the polysaccharides pectin, hemicellulose, and cellulose. These busted-up chunks of cells tend to make juices thick and gloopy, which in turn makes them difficult to clarify, because they don’t flow or drain well. Pectin in particular tends to stabilize the particles in juices and purees, making them more difficult to remove. You need to knock out these stabilizers to free the suspended particles so you can separate them out.

How do you destabilize a juice? Add enzymes.

Destabilizing: The Magic of SP-L: Ninety-nine percent of the stuff you’ll want to clarify is stabilized by pectin and thickened by busted-up cell parts. Luckily, both of these hindrances can be handled with a single concoction of enzymes called Pectinex Ultra SP-L. Just call it SP-L. I call it my secret ingredient; about 75 percent of my drinks involve SP-L at some point. It is a mix of enzymes that are purified from *Aspergillus aculeatus,* a fungus found in soil and rotting fruit. Fungi are the world’s champions at enzymatic breakdown of everything, and *A. aculeatus* is a great generalist. It produces enzymes that obliterate most things that get in clarification’s way: pectin, hemicellulose, and cellulose.

The strawberry puree on the left was treated with Pectinex Ultra SP-L. The puree on the right is untreated.

SP-L maintains its activity over a wide range of temperatures, pHs, and ethanol concentrations. The ethanol bit is extremely important. Many enzymes don’t work well—or at all—in concentrated alcohol solutions. SP-L does, so you can clarify booze with it. SP-L-treated juices clarify quite well in a centrifuge that operates at 4000 g’s or even a bit less, so SP-L makes reasonable centrifuges worthwhile. SP-L works so well that some juices can be clarified without a centrifuge. Apple juice with SP-L will settle on its own enough to rack off clarified juice. I still use a centrifuge on apple juice to increase my yield, but you don’t have to.

Pectinex Ultra SP-L ate the pith off of these grapefruit wedges to make these beautiful suprêmes. This trick works on all citrus I have tried—including pomelos, which are notoriously difficult to suprême—except limes.

Using SP-L: Using SP-L couldn’t be simpler. I always use 2 milliliters (roughly 2 grams) of SP-L per kilo or liter of juice. That’s twice the amount used industrially, but sometimes I can’t be sure how well my enzymes have been stored or how old they are, and both those factors affect potency. Remember that ratio: 2 grams per liter. Never tell someone to add 0.2% SP-L; they will almost always add 20 grams per liter, I don’t know why. The really good news is that that 2 grams isn’t critical—little more, little less, no problem. Don’t go enzyme-crazy, though. The stuff on its own tastes fermented and weird. You don’t want a perceptible amount in your juice. Even when you are gel clarifying, using SP-L is often a good idea. Knocking out the stabilizers before you clarify can increase the yield of clarified juice you get by 30 percent or more, because thinner products leak out of gels better than thick ones do.

MAKING THE CITRUS VESICLE (GROSS BUT ACCURATE WORD) GARNISH: *I use grapefruit here but the real show-stopper is blood orange:* ***1)*** *Cover the citrus suprêmes with liquid nitrogen.* ***2)*** *Make sure the suprêmes are frozen—it will take more liquid nitrogen and time than you think.* ***3)*** *Smash the suprêmes with a muddler.* ***4)*** *They should look like this.* ***5)*** *Allow them to thaw and* ***6)*** *use as an elegant garnish on any gin drink.*

I was hooked on SP-L from the moment I got my first sample. Like a drug dealer, Novozymes, the manufacturer, gave me the first sample free, but then I had to pay. Novozymes and its distributers aren't set up to sell reasonable quantities to normal folk. The smallest amount they will sell—and grudgingly at that—is a 25-liter pail. Twenty-five liters of SP-L is enough to clarify over 12,500 liters of juice and costs $570. Not a bad deal, really, but way more than you need. Luckily, online suppliers have started selling the stuff in smaller quantities with extremely fast shipping; see

Sources, here.

When SP-L Doesn’t Work: Occasionally you will run into a fruit with pulp that is resistant to SP-L; some jungle fruits from Colombia with local names I can’t recall come to mind. Other fruits, like tamarind, can become SP-L-resistant if the seeds are pureed with the pulp. In these cases a hydrocolloid thickener (complex long-chain polysaccharide) other than pectin is present in the product and the SP-L can’t dissolve it. In these cases, you are SOL.

SP-L won’t break down starch. Starchy products such as sweet potatoes and underripe bananas will always give a cloudy result with the ~4000-g centrifuges I use.

Most important, SP-L doesn’t work perfectly in very-low-pH products such as lime juice (which has a pH of 2 and change). Grapefruit juice’s acidity, at roughly pH 3, is right on the edge of what SP-L can handle with aplomb on its own. With these acidic products, SP-L is still useful, but it can’t work alone: you’ll need further interventions. I use wine fining agents, which gave me the final key to clarified lime juice.

SP-L AND TEMPERATURE

I usually warm ingredients I’m treating with SP-L, because SP-L works much more rapidly if it is warm—unless it gets too warm and gets denatured. I use body temperature as a reference, because body temperature is mostly constant, easy to judge, and warm enough to be effective but cool enough not to change my ingredients’ flavors or destroy the enzyme. At body temperature, SP-L works in a few minutes. At refrigerator temperature, I have to let the enzyme work for an hour or more. If you are starting with juice or premade puree, add the enzyme directly to the juice or puree and mix thoroughly. If you are blending products to make a puree, add the SP-L directly to the blender with your fruit or veggies; it will help liquefy the puree as you blend. I use a Vita-Prep blender, which is so powerful that the friction of the blades spinning on high slowly heats my purees to just above body temp, and that is what I recommend you do if you have one. Heating with a blender never scorches anything, which is why I like to do it that way. If you don’t have a Vita-Prep, soak uncut fruits in warm water for a couple of minutes to heat them to just above body temp, or else let the puree rest an hour or more for the enzyme to work before proceeding with clarification.

FINING

In winemaking, fining is the process of adding small amounts of specialized ingredients to the wine to get all the cloudy impurities to clump together—

flocculation—and aggregate in large enough masses for gravity to pull them to the bottom of the vat relatively quickly. Most fining agents rely on electrical charge to do their work. You see, most of the particles that are floating in wine, or your juice, have some sort of charge on them. By adding a fining agent with the opposite charge, you can get those impurities to clump together, making it easier to get them to settle to the bottom. If the cloudy particles still aren't big enough to settle, you can use a counterfining agent. A counterfine has the opposite charge to the fining agent. It will mop up anything in the juice that the first fining agent couldn't catch, plus get the already-clumped-up stuff to clump up into even bigger particles.

Normally, in wine, you do two steps: fine, then counterfine. That doesn't work for lime juice. I figured out that to get lime juice to work, you need three steps: fine (and add SP-L), counterfine, and fine again.

The fining agents I use are kieselsol and chitosan. You can get them at any home-brew shop. Kieselsol is food-grade suspended silica; it has a negative charge. Chitosan is a positively charged hydrocolloid that comes from shrimp shells. The solution they sell at the home-brew shops is 1 percent chitosan in a weakly acidic aqueous solution. Chitosan comes from chitin, the second most common polymer on earth after cellulose. Every bug and crustacean on the planet is protected by a chitinous shell, and mushrooms and other fungi build their cell walls with chitin. The shrimp origin of chitosan is the only fly in the buttermilk of my clarification bliss. It doesn't end up in the product (it is spun out) and it is non-allergenic (I've tested chitosaned lime juice on folks with shellfish allergies), but I'm still using an animal product, and I would rather not. Luckily, non-animal-based chitosan is now being made and should be available soon.

Both kieselsol and chitosan are used in small quantities: 2 grams per liter. Unlike SP-L, the amount of fining agents you use is critical. Too much is as bad as too little. If you add too much, you can actually stabilize the particles you are trying to floc together.

The powerhouse wine-fining agents I use, kieselsol—suspended silica sol—and chitosan—a polysaccharide derived, in this case, from shrimp shells and prepared in an acidic aqueous solution.

What fining agents do to for you: At left is untreated, cloudy lime juice. The second tube has lime juice that I treated with SP-L and negatively charged kieselsol. A lot of the solids have settled, but the juice is still cloudy. Fifteen minutes later, I added positively charged chitosan to tube three. The chitosan agglomerated the negatively charged kieselsol, and the lime juice settles much more than in tube three, but is still cloudy. Fifteen minutes later I added more kieselsol to tube four. Notice this juice is crystal clear, but now the cloudiness isn't settling as much. This is a common problem, because the last particles that kept tube three cloudy don't settle as much as heavier, earlier floccing particles do. A centrifuge smashes all the solids from tube four into a tiny pellet and increases our yield to nearly 100 percent. Look at how little the pellet is. It doesn't take much to make a liquid cloudy.

OTHER COCKTAIL USES FOR SP-L

SP-L dissolves the white pithy part—the albedo—of citrus peels. If you make perfect citrus peels by cutting wedges into the fruit with a knife and removing perfect triangles, you can vacuum the peels in a bag with a solution of 4 grams SP-L per liter of water and let it soak for several hours. When you remove the peels from the bag, the albedo will have turned to mush. Brush it away under water with a toothbrush.

Some nice garnishes can be made this way. SP-L doesn't really work on lime peels (of course). Kumquats cut in an *X* shape can be soaked in SP-L to make kumquat flowers. Last, SP-L can be used to auto-suprême citrus segments. A citrus suprême is a wedge of fruit without all the connective tissue that surrounds it. Old-school kitchen technique is to make suprêmes with a knife—a good technique, but flawed in that it is wasteful of fruit and requires you to cut into the individual sacs of pulp so they leak. A better way is to peel your fruit, separate it into four parts, and soak it in a solution of 4 grams per liter SP-L and water for a couple hours. Whatever connective tissue isn't melted outright can be rubbed off or peeled away with ease. These suprêmes look beautiful. A great trick is to freeze them with liquid nitrogen and shatter them. They will shatter into their individual juice sacs without leaking. You can then do things like float blood-orange bits on top of your drink without spoiling the overall appearance of the cocktail.

CLARIFICATION TECHNIQUES AND FLAVOR

Clarification changes the flavor of ingredients. That's right—clarification changes the way things taste. Usually the particles floating around in your drink making it cloudy are also contributing some kind of flavor. The flavor of the particles is often not identical to that of the liquid they are floating in, so when you strip the particles out, you alter the flavor of the remaining liquid.

Whether the flavor change is good or bad is context-dependent. Clarifying grapefruit removes some of its bitterness, making it friendlier for many cocktails and worse for others. Sometimes the SunnyD flavor that you get when you clarify OJ helps a drink out, and other times it's gross.

How much you change the flavor of your ingredients depends on the ingredients you have and the techniques you use. In general, gel clarifications strip more flavor than mechanical (centrifugal) clarifications do. Treating a juice with SP-L has very little effect on flavor—it merely obliterates tasteless pectin—but SP-L can indirectly alter the flavor of your juice by increasing your yield. For example, one of the characteristic notes of red plum juice is astringency from the skins. Astringency is leached into the juice from the skins as it sits waiting to be clarified. As the yield of clarified juice increases, extra nonastringent juice is released from the interior pulpy part of the plums, reducing the overall astringency. Life is never simple.

Wine fining agents can have major taste impacts, but I chose kieselsol and chitosan because they don't strip flavor heavily in the dosages I use. Some other fining agents are known flavor thieves.

Clarification Techniques: Nitty-Gritty Flowcharts

Here is where you want to start reading again if you skipped the theory. I'm going to assume you fall into one of two camps, those with a centrifuge and those without. Choose your camp and I'll tell you how to proceed from there.

I DON'T HAVE A CENTRIFUGE: STEP 1

Look at what you want to clarify. Is it pretty thin? Is it less acidic than grapefruit juice? Does it start to settle a bit on its own? Will it last a day in the refrigerator without losing quality? Unpasteurized apple juice, pear juice, carrot juice, and even orange juice are like this. You can often clarify such juices just by adding SP-L and letting the solids settle. Settle ʼn' rack doesn't provide good yield but couldn't be simpler. Expect to lose between one-third and one-quarter of your product (well, you don't lose it, but it won't be clarified).

1A: MY PRODUCT IS THIN, SEPARATES EASILY, AND IS LESS ACIDIC THAN GRAPEFRUIT. I'M GOING TO RACK.

Add 2 grams Pectinex Ultra SP-L to every liter of juice. Stir thoroughly. Put the juice in a clear round container. Your container should be clear so you can see what is happening. Your container should be round because when square containers are moved around, they kick up particles. Put the juice in the fridge overnight and let it settle. Carefully pour the clear juice off the top**. You're done.**

Here I use a separatory funnel (sep funnel) to separate the solids from liquids in orange juice. A sep funnel lets you "reverse rack." Normally when racking you remove the clear liquid off the top of the solids. With a sep funnel, you drain the bottom off.

A mixture of strawberry puree and apple juice that I have treated with SP-L and am trying to clarify by racking alone. Right after treatment the juice looks like ***(1)****. Even after a couple hours of sitting, the juice looks like* ***(2)*** *which has two problems: the juice is still cloudy, and the airy foam caused by juicing and blending hasn't settled. The solution? Stir in a bit of kieselsol (the wine fining agent). The stirring will help break up the bubbles and get the solids to settle and the kieselsol will mop up the last cloudy particles* ***(3)****. Notice that clarity has its price: the yield in the last glass is low.*

1B: MY PRODUCT IS THICK, OR DOESN'T SETTLE, OR IS MORE ACIDIC THAN GRAPEFRUIT. I'M USING AGAR.

You are going to use agar to clarify. Buy powdered agar, because it is the easiest to use. Always buy the same brand. Different brands of agar will have slightly different properties. Get used to one brand and stick with it. I use Telephone Brand from Thailand.

Unless you are clarifying lime or lemon juice, you have the choice of freeze-thaw or quick clarification. Lime and lemon should only be quick clarified. The beginning steps are the same either way. **Go to Step 2**.

Telephone brand agar-agar. The hydrocolloid so nice they named it twice.

STEP 2: PRETREAT WITH SP-L?

Any thin juice that is made with a juicer does not need to be pretreated with SP-L: cucumber, citrus, and the like. If your product is like that, **go to Step 3**. Any thick juices or purees you want to clarify need to be treated with SP-L or your yield will be awful: blended tomatoes, strawberries, raspberries, or similar. To pretreat, add 2 grams of Pectinex Ultra SP-L to every liter (or kilo) of product. If you are blending, add the SP-L directly to the blender. If your product is cold, give the SP-L an hour or so to do its work. If your product is near body temperature, the SP-L will work in just a couple of minutes. **Go to Step 3**.

STEP 3: DIVIDE YOUR BATCH

Figure out the volume or weight of product you want to clarify. Weight or volume doesn't really matter here—they usually work out close enough. Do what is convenient. First, allow your product to come up to room temperature. If your product is too cold, you will have problems in Step 6. Then make the following choice:

3A: MY PRODUCT IS NOT SUPER-HEAT-SENSITIVE, AND IS THIN

Orange, grapefruit, ginger, and similar juices are like this. You are going to separate out one-quarter of your total batch and heat only that quarter with the agar. Afterwards you will recombine the agar with the rest of the batch. This is okay because you aren't heating that much of it, and it is relatively easy to hydrate agar in thin liquids. For example, if you start with 1 liter of grapefruit juice, divide it into a 750-milliliter sample and a 250-milliliters sample. You will add the agar to the 250. **Go to Step 4.**

3B: MY PRODUCT IS HEAT-SENSITIVE, OR ALCOHOLIC, OR THICK

Lime juice, strawberry puree, and gin blended with raspberries fall in this category. In these cases, you don't want to heat the products directly. Instead you will heat the agar in water and then combine the agar-water with your product. For every 750 milliliters or 750 grams of product, measure out and reserve 250 milliliters of water. In Step 5 you will add the agar to the 250 milliliters of water. Does this extra water dilute the juice a little? Yes, but in my experience, not as much as you'd expect. Strangely, for products like lime juice, the difference is often negligible. **Go to Step 4.**

If the ingredient you are clarifying is alcoholic or heat sensitive you should hydrate the agar in pure water. Here we have 750 ml of lime juice 250 ml of water and two grams agar.

STEP 4: MEASURE YOUR AGAR

STEP 4: MEASURE YOUR AGAR

Now that you have measured and divided your batch, you are going to weigh out 2 grams of agar for every liter of total stuff you are going to clarify. So if you are doing an all-juice clarification, like grapefruit juice, you will measure 2 grams of agar per liter of juice. If you are doing a juice-water clarification, like lime juice, you will measure 2 grams of agar for every 750 milliliters of juice and 250 milliliters of water. Got it? **Go to Step 5**.

STEP 5: HYDRATE THE AGAR

Do not add agar to hot liquid. It will clump. Add agar to liquids at body temperature or below. Add the agar to the *small* batch of liquid or water you have reserved from Step 3 and then stir vigorously with a whisk to disperse the powder. When the powder is dispersed, turn on the heat. Agar needs to be heated to the boil and held there for a couple minutes to hydrate properly. (For those of you at high altitudes, I have successfully hydrated agar in Bogotá, Colombia, elevation 8612 feet/2625 meters, local boiling point 196°F/91°C—but it was a pain). Continue to stir while your product comes up to the boil, then turn the heat down and cover the pot; you don’t want to boil off too much liquid. **Go to Step 6**.

STEP 6: TEMPER THE BATCH

Add the unheated liquid to the hot agar solution, not the other way around. If you add the hot stuff to the cold, the temperature will drop quickly and the agar will gel before you want it to, spoiling your clarification. Unlike gelatin, agar sets into a gel extremely quickly once it cools below its gelation temperature, around 35°C (95°F), or just below body temperature. Use a whisk to keep the agar fluid moving as you add the rest of the batch. When you are done, the entire batch should be just above body temperature. Now you can see why I had you let your product come to room temperature in Step 3! **Go to Step 7**.

STEP 7: SET THE AGAR

Pour your batch into a bowl, pan, or tray to set. In professional settings I use 2-inch-deep hotel pans; my Euro friends will know them as gastro-norms. Use whatever you like. Your product will eventually gel at room temperature, but I accelerate the process by putting my setting container in the fridge or in an ice-water bath. Do not mess with the agar while it is setting. I repeat: do not mess with the agar while it is setting. Many people I have trained have an irresistible pathological desire to stir a gel while it is setting. Wrong! When you think your agar has set, lightly touch the top. It should feel like a very, very loose gel. Tilt your container slightly—slightly! The gel should not run. You are ready to make your big decision: freeze-thaw or quick? **Go to Step 8**.

STEPS 5, 6, AND 7 OF AGAR CLARIFICATION: 1) *Remember to whisk agar into your liquid before you apply heat to so that the agar disperses properly, then heat and simmer for several minutes while stirring.* ***2)*** *Always add juice to the hot agar solution while whisking vigorously, not the other way around.* ***3)*** *Pour the tempered agar and juice into a suitable container (preferably over ice) and allow it to set undisturbed. I mean it. Leave it alone. Let it set.*

STEP 8: FREEZE-THAW OR QUICK CLARIFICATION?

If you need your stuff right away, go quick. If you have time and freezer space, freeze-thaw will provide a slightly better yield with fewer headaches. Also, quick-clarified products tend to develop agar wisps when stored longer than a day or so. You can stir them back in, but they are irritating.

8A: Freeze-Thaw

Put your container of set agar gel in your freezer and let it freeze solid. As long as the gel is 2 inches thick or less, it should freeze solid overnight. Once it is frozen, crack it out of its container. Don’t use hot water or a torch. Don’t shatter it into a billion pieces. There is an art to unmolding frozen gels that involves getting very angry with the containers holding them. I grab the edges on opposite sides and pull like a demon, working my way around the container. I then flip it over and punish the bottom of the vessel till the gel releases.

***FREEZE-THAW TIPS:* 1)** *Make sure your juice is thoroughly frozen—don't rush it.* **2)** *To get the frozen juice out of the pan, pull on it hard, like you are drawing a strong bow, then rotate 90 degrees and repeat.* **3)** *Put a cloth on your work surface, flip the pan and push with force.* **4)** *Put the frozen juice in a cloth suitable for draining and place on a rack or in a perforated pan over another pan to catch the drippings. Allow it to thaw a while on the counter and finish thawing in the fridge.* **5)** *The spent raft.*

Once the gel is released, put it into some form of draining cloth. Normally people specify cheesecloth for this, but the average cheesecloth is absurd and close to gauze. Worthless! You are better off using an unbleached cotton tablecloth. Put the gel in the cloth into a colander set over a collection container and let it thaw. You can leave it out a couple of hours to kick-start the thawing. Once the gel starts dripping a lot, transfer it to the fridge to continue thawing. Every once and while, drain off and save what you have. When it looks like the agar is spent and what is dripping out is devoid of flavor and color, you are done. Combine all the drippings together and enjoy. **You're done.**

8B: QUICK

Get a whisk and gently break up your gel. It should resemble broken curds. Pour the curds into an unbleached cloth napkin or filter sack and let the clear juices flow into a container. Resist the urge to squeeze on the gel too hard. If you squeeze hard, you will push cloudy agar bits through your filter and into your juice. Bad. You will find that the filter clogs rather quickly. Gently pinch a portion of it in your fingers and rub the cloth against itself to free up the pores. I call this massaging the sack. Massaging the sack and applying just the right amount of pressure are the finesse skills you must develop to do this technique properly. It takes some practice. An alternate technique I show people is to tie your filter sack shut and throw it into a salad spinner. The spinner does a good job of gently extracting the liquid, and you can't spin too hard with a salad spinner. You still need to massage the sack between spins! **You're done.**

QUICK AGAR:* 1)** *Once the agar has set, gently break the gel with a whisk so it looks like curds.* ***2) *Pour the curds into a draining cloth and let it drip.* ***3)*** *As the cloth clogs, gently "massage the sack". If you squeeze hard you will push agar through the cloth and ruin your product.* ***4)*** *Quick agar is not quite as clear as freeze-thaw. This juice could be passed through a coffee filter to catch the errant bits of agar in it.*

AN ALTERNATIVE TO MASSAGING THE SACK: *tying the top of the sack closed and putting it in a salad spinner—the poor cook's centrifuge. In between spins you still need to do some massaging to unclog the cloth, but this method is almost foolproof.*

I HAVE A CENTRIFUGE: STEP 1: ADD SP-L

Add 2 grams of Pectinex Ultra SP-L to every liter or kilo of product you want to clarify. If you are blending fruits like strawberries, blueberries, peaches, plums, apricots—whatever—add the SP-L directly to the blender and blend till the product is just above body temperature. Remember, this process won't clarify starchy things completely. **Go to Step 2**.

STEP 2: ASSESS ACIDITY

2A: MY PRODUCT IS LESS ACIDIC THAN GRAPEFRUIT JUICE

If your product is body temp when you add the SP-L, you are ready to spin. If your product is refrigerator temperature, give the SP-L an hour to work. **Go to Step 3**.

2B: MY PRODUCT IS SIMILAR TO OR MORE ACIDIC THAN GRAPEFRUIT JUICE

2B1 When you add the SP-L to the juice (Step 1), also add 2 grams per liter of kieselsol (suspended silica) and stir. This measurement needs to be fairly accurate. I use a micropipette to measure it, because micropipettes are fast and I do this a lot.

2B2 Wait 15 minutes.

2B3 Add 2 grams per liter of chitosan (1% chitosan solution) and stir well. Again, this measurement must also be accurate.

2B4 Wait 15 minutes.

2B5 Add 2 more grams per liter of kieselsol (measure accurately) and stir. **Go to Step 3**.

STEP 3: PREP AND SPIN

Air bubbles won’t necessarily pop in the centrifuge when you spin. If the bubbles don’t pop, you will get floaty doodles on top of your product when you spin. I hate floaty doodles. Bananas don’t make them, but tomatoes do; it is hard to predict. If you have a chamber vacuum machine, you can use it to de-aerate your product before you spin, which will obliterate floaties, but this step is optional. When you load your centrifuge, make sure to balance it properly, and then spin for 10 to 15 minutes at 4000 times the force of gravity. If you don’t have a refrigerated centrifuge, make sure your buckets are extremely cold before you spin so your product doesn’t heat up. **Go to Step 4**.

STEP 4: POUR OFF THE PRODUCT

When you pour your product out of the centrifuge tubes or buckets, it is good practice to pour through a coffee filter or fine strainer to catch anything that might be floating on top or in case the puck breaks free and falls toward your clarified product. **You are done.**

REALLY ADVANCED CENTRIFUGED GRAPEFRUIT

Centrifuge-clarified grapefruit juice tastes more bitter than agar-clarified grapefruit juice does. The agar gel traps and holds on to a portion of the bitter molecule in grapefruit, naringin. In my carbonated cocktail Gin and Juice (here), I think the less bitter juice is better, but centrifuging is a far more convenient technique for me to use at the bar: better yield and much faster. In a technique similar to washing, you can use agar to strip some of the naringin from grapefruit juice that is clarified in a centrifuge.

You do this by making an agar fluid gel. A fluid gel is something that acts like a gel when it is standing still but acts like a liquid when you stir it or agitate it. Chefs use fluid gels to make sauces that plate like purees but feel very liquid in the mouth. Thinner fluid gels are used to suspend objects in drinks or soups. You aren’t using any of those properties here. An agar fluid gel is a bunch of tiny gel particles suspended in a liquid. All those tiny particles have a huge surface area that will help gel particles suspended in a liquid. All those tiny particles have a huge surface area that will help soak up naringin and are easy to spin out of suspension with a centrifuge.

To make the fluid gel you first make a regular grapefruit gel with 1 percent agar—10 grams of agar per kilo of juice—and set it solid. This is a much firmer gel than you use in gel clarification. Put the gel in a blender and blend until totally smooth. With this step you have created a fluid gel.

Add 100 grams of the grapefruit fluid gel to every 900 grams of regular grapefruit juice right when you add the SP-L and kieselsol as part of your normal centrifuge routine. Proceed as usual with the rest of clarification and you will have a less bitter grapefruit juice.

On the upper left is grapefruit juice gelled solid with 10 grams of agar per liter of juice. On the lower right is that same gel blended into a fluid gel. Fluid gels are fantastic in culinary applications because they plate like a puree but eat like a sauce. Here we use it to strip naringin from grapefruit juice in centrifugal clarification.

Clarifying Booze in the ’Fuge: The Justino

Bad news: you need a centrifuge to try the following technique. Good news: once you have a centrifuge, this technique will change your drink-making life.

Turns out you can make a beautifully clear spirit from a straight liquor and the fruit or vegetable or spice of your choice. You blend the liquor and the other ingredients, add the enzyme Pectinex Ulta SP-L, and use a centrifuge to spin this mix into a clear spirit that I call a Justino (pronounced *whoo-stee-no*). (If the process in that last sentence holds no meaning for you, read the earlier part of this clarification section). Justinos rely on the fact that Pectinex Ultra SP-L, an enzyme that destroys the structure of blended fruit and allows effective clarification, works quite well in highly alcoholic solutions. Many enzymes don't.

The birth of Justino went something like this: I was interested in making a banana cocktail that wasn't thick and gloopy like a smoothie. While there are plenty of banana-flavored liquors, I wanted to use just the straight juice, and I wasn't having much success making it. My yields were poor, and the taste was off. I knew I needed to add more liquid to the banana to up the yield, but I didn't want to add a non-alcoholic liquid, so I just blended the bananas with the booze and centrifuged it clear. The result was rum with pure banana flavor. Beautiful! When a reporter asked me what the liquor was called, I came up with Justino—and the name stuck.

Although you can blend almost anything into booze to make a Justino, I like to use low-water products so the alcohol content stays high. I find that higher-proof Justinos mix better and last a lot longer than lower-proof ones. Lower-proof Justinos tend to be less versatile and have unstable flavors. If you want to Justino with high-water products like honeydew melon, you should put those products in the dehydrator before you blend them with the liquor. Commercially produced dried fruits are great choices for Justinos.

Starchy products don't work well. The SP-L enzyme doesn't break starches down and the liquor will not clarify in the low-speed centrifuges that are commonly used in restaurants and bars. For instance, you can't make a good Justino with unripe bananas—they have too much starch.

THE JUSTINO PROCESS: 1) *Add fruit to liquor,* ***2)*** *then Pectinex Ultra SP-L,* ***3)*** *then blend at high speed until the friction of the blender heats the mix up to body temperature. I use the back of my hand on the pitcher to judge the temperature.* ***4)*** *Pour the mix into centrifuge buckets, making sure to balance the buckets, and* ***5)*** *place them in the centrifuge and spin for 10–15 minutes at 4000 times the force of gravity.* ***6)*** *Pour off the clear Justino.*

The basic starting recipe for Justino is 250 grams of fruit or vegetable for every liter of liquor, a ratio of 1:4. This is a good starting point. If you are using an ingredient that has very low water content and the mix seems to be more of a paste than a puree, lower the ratio to 200 grams of fruit or vegetable per liter of liquor—1:5. Sometimes you might even do 1:6. If your Justino is too thick before you spin it, your yield will be low. Sometimes if your yield is too low and your Justino ratio can't be reduced further without damaging flavor, you can fix the problem *after* you spin by adding some water to the puck and spinning again (see the Apricots Justino recipe here for the technique).

After you spin the product, taste the Justino. If it is too weak and your yield is high, increase the ratio of solids to liquor. If the ratio is already high and the Justino tastes watery, dehydrate your solids more before making the Justino. If the Justino is too strong in flavor (usually too sweet), start adding straight liquor till you like it. Once you find a ratio you like, you can try using that ratio from the beginning the next time you make it, or you can just keep making the Justino the same way and add fresh liquor at the end. Strangely, the two techniques produce different-tasting liquors. Sometimes one is better than the other. You will just have to test, taste, and see for yourself. Here is an example.

Let's say you are making a Justino of Medjool dates in bourbon and you test my recommended ratio of 1:4 dates to liquor. You will find that the yield is okay but the Justino is too sweet. Most likely, you'll like it best when you add 250 milliliters of fresh bourbon to every 750 milliliters Justino, an equivalent Justino ratio of 1:5.3. Strangely, you will also find that if you make the same Justino with an initial ratio of 1:5.3, it doesn't taste as good as the 1:4 Justino with the fresh liquor mixed in. I don't know why.

BANANAS JUSTINO

SOME OF MY FAVORITE JUSTINOS

BANANAS JUSTINO: 3 peeled ripe bananas (250 grams) per 750 ml of liquor. Works well with aged rums (not rums that have caramel color added; the Justino process strips it out), bourbons, even Hendrick’s gin. Remember that the bananas must be ripe: brown but not black. If they are not ripe, the starch in them will create a cloudy drink with a starchy taste. This liquor is fantastic poured over a rock and served with a wedge of lime and a pinch of salt. For a real treat, keep the lime but pour the Justino over a large ice cube made from high-quality coconut water, and float a star anise pod on top.

DATES JUSTINO: 187 grams Medjool dates per 750 ml liquor. Justino, then add 250 ml of fresh liquor. Works well with bourbon, Scotch, and Japanese whiskey. Serve over a rock with a dash of bitters.

RED CABBAGE JUSTINO: Dehydrate 400 grams of red cabbage to 100 grams and Justino with 500 ml Plymouth gin. If you skip the dehydrating step, your drink will smell like an ill wind from the nethers. Works well in shaken drinks.

To make Justinos out of cabbage, ***1)*** *dehydrate the cabbage until* ***2)*** *it has lost ¾ of its initial weight.* ***3)*** *Red-cabbage Justino.*

APRICOTS JUSTINO: Use dehydrated apricots for this. I prefer Blenheim apricots from California as the base of this Justino. In my opinion, they are the royalty of dried apricots. Blenheims are full of flavor and have a lot of bright acidity. If you use any other apricot, the results will be totally different. Make sure not to get apricots that are untreated for oxidation. The most common treatment is sulfuring, but there are others. It is easy to tell if an apricot has not been treated—it will be brown and taste oxidized.

Blenheim Justinos are one of the few that I actually think are low in sugar. You can either add a bit of sugar to the finished product or substitute garden-variety dried apricots (which have less acidity) for a portion of the Blenheims. Apricots absorb a lot of liquor during the Justino process, so yield is low.

Here is how to proceed: Make a Justino with 200 grams of dehydrated Blenheim apricots and 1 liter of liquor. When you drain the Justino, save the pucks of apricot solids from the centrifuge buckets, place them in a blender with 250 ml filtered water and an additional 1 to 2 grams SP-L, and blend. I call this a remouillage (rewetting), or remmi, after the French technique of adding a second batch of water to extract used stock ingredients a second time. Spin the remouillage in the centrifuge and add the resulting clear liquid to the original Justino. This process pulls out a good bit of the trapped alcohol and flavor from the pucks, so add it to the first-spin Justino.

This recipe works well with genever, gin, rye, vodka. . .I'm hard-pressed to think of something it wouldn't work with.

PINEAPPLES JUSTINO: Use 200 grams of dried pineapple per liter of liquor. As with Apricots Justino, do not use the "natural"-type dried pineapples, which are brown and sad-looking/tasting. This recipe works well with dark or white rum—but you already knew that. Try it with whiskey or brandy for more of a pineapple-upside-down-cake feeling.


TEA TIME

Washing

In 2012, ESPN asked me to make an alcoholic version of the Arnold Palmer, a mixture of iced tea and lemonade named for the famous golfer. I replied that the Arnold Palmer is clearly best as a nonalcoholic drink; diluting and chilling an alcoholic tea cocktail makes the tea's astringency too dominant. Think of how a big, tannic red wine tastes when it is too cold, then multiply that effect in your mind, and you get the idea. I made the film crew several alcoholic Arnold Palmer variants. We all agreed they weren't very good.

After the crew left, I got to thinking. Many people, especially in the U.K., take their tea with milk. Milk proteins—casein in particular—bind with the tannic, astringent compounds in tea and mellow the brew. I decided to make some tea-infused vodka, add milk, and then curdle the milk-vodka to clarify the liquor and remove the astringency. I steeped tea in vodka till I had a very strong decoction, then added that vodka to milk and stirred in a little bit of citric acid solution. It worked beautifully. The milk broke and the solids settled to the bottom. I spun my vodka in a centrifuge (because I have one, but you can just strain the liquid through a fine cloth). I reduced the astringency of the tea so much that the cocktail tasted balanced even when cold, though the tea flavor was still very strong. When I added simple syrup and lemon juice to the tea vodka and shook it with ice, I reaped an unintended side benefit: booze washed with milk this way gets a silky texture and makes an incredibly rich head when shaken. Although the casein in the milk curdles and is removed in the washing process, the whey proteins remain—and they are fantastic whipping agents.

Milk washing, therefore, has two purposes: it reduces astringency and harshness, and it augments the texture of shaken drinks.

The concept of washing liquids takes a little getting used to. You wash clothes to remove dirt; you wash ingredients to remove flavors. You can use washing in your cocktail ventures in two different ways. You can *booze-wash*, as I did in the Arnold Palmer, by adding a "detergent"—usually milk, gelatin, hydrocolloids, or eggs—to bind with unwanted compounds in the liquor so that you can remove them. You can also *fat-wash* to wring good flavors out of a fat and into a liquor, and then use that liquor to make something delicious. In the first example you're washing a liquor; in the second you're washing a fat.

Good news: all the techniques in this section can be pulled off without fancy equipment, although having a centrifuge is nice for some. Let's tackle booze washing first.

POLYPHENOL ASTRINGENCY AND PROLINE-RICH PROTEINS

The astringency of a polyphenol correlates well with how strongly it binds to a specific group of salivary proteins called proline-rich proteins (PRPs). These proteins contain large amounts of the amino acid proline. The prolines give the proteins more affinity for polyphenols. If you remember, plants produce astringent polyphenols to make themselves less digestible and therefore less likely to be eaten. PRPs in saliva bind with the polyphenols and mitigate their antidigestive properties—an herbivore's countermeasure to the plants' defense mechanism. Tellingly, carnivore spit doesn't have PRPs. Tigers eat only meat, not leaves and bark, so they don't need the PRPs. Herbivores have lots of PRPs in their spit. We, as omnivores, are in between.

Many other proline-rich proteins besides saliva PRPs also bind to polyphenols, including milk protein (casein), egg whites, and gelatin. These are the proteins that we use in booze washing.

Booze Washing

To remove flaws from poorly distilled spirits you typically use hard-core flavor- and color-stripping media such as activated charcoal. We are not talking about that kind of removal here. We are talking about selectively stripping flavors from perfectly good booze. Why would we do this? Because certain flavors, while nice on their own, can overwhelm the other ingredients in a cocktail. Bourbon, for example, is delicious. Bourbon cocktails are delicious. Carbonated bourbon cocktails? Often not delicious. The pleasing woodiness in bourbon becomes harsh and overpowering when carbonated. You *could* just add less bourbon, or perhaps cut the bourbon with a neutral spirit like vodka, but isn't it better just to moderate that harshness and leave the rest of the bourbon flavors intact? Another example: Black tea tastes good. Black tea vodka tastes good. Cocktails made with black tea vodka are usually not good—they are harsh, astringent, and difficult to balance properly. You *could* just dial back the tea in the cocktail till the astringency didn't bother you anymore . . . or you could moderate the harshness by washing the booze, leaving the rest of the tea flavor intact. Choose washing!

BOOZE-WASHING SCIENCE

BOOZE-WASHING SCIENCE

The flavors we target with booze washing are called polyphenols, a group of chemicals produced by plants, often as a defense against predators or damage. Polyphenols are decent defense mechanisms because they typically have bactericidal, insecticidal, and antidigestive properties that animals leave alone. Many polyphenols are astringent. Tannins, for instance, are polyphenols, and their presence in grape seeds and skins is responsible for the tannic flavors of red wine. Ditto the tannic flavors in cranberry, cassis, and certain apple varieties. Polyphenols in oak wood give whiskey and brandy their trademark woodiness. You might remember from the nitro-muddling section of this book that a damaged herb leaf causes enzymes called polyphenol oxidases to link small phenolic molecules together into large, dark-colored polyphenols. In tea, those polyphenols are desirable: they create the characteristic astringency of dark tea.

To attack polyphenols, I steal from the winemaker's playbook. The winemaker combats the problems of excess astringency, protein haze, off flavors, and turbidity through a process called fining: adding small quantities of ingredients to wine to correct for perceived problems. I use these same ingredients for booze washing. They all rely on some combination of three basic principles: protein binding, charge, and adsorption.

PROTEIN BINDING

Protein-rich agents—egg white, blood (yep), gelatin, casein (milk protein), and isinglass (fish gelatin)—bind to impurities in a complex way. Proteins are very good at stripping tannins and other polyphenols. They also strip color and some flavors, which can be good and bad.

CHARGE

Some agents rely solely on electric charge to do their work. Kieselsol (suspended silica) and chitosan (a polysaccharide found in all arthropod skeletons and in some fungi) are two such agents. Kieselsol has a negative charge and will therefore attract positively charged impurities, while chitosan is positive and will attract negatively charged impurities (for more on these two agents, refer to the Clarification section, here) The polyphenols that we seek to reduce when we booze-wash are negatively charged, so chitosan, with its positive charge, is our best electrostatic weapon.

ADSORPTION

Other agents rely on adsorption, the process of a liquid or gas sticking to a surface. Adsorptive agents, such as activated charcoal, have an immense surface area of tiny pores that trap impurities. Adsorptive agents tend to be rather broad-spectrum flavor muters—too blunt an instrument. I don't use them much.

Every fining/booze-washing agent removes different flavors in different amounts, and some bring textures and flavors of their own. While wine fining is still a bit of a dark art, there's plentiful information to guide the booze washer; I have called out some sources in the bibliography. My booze washing differs from wine fining in some key ways. I focus on quick results, while wine fining is typically a slow process. I use large amounts of fining agents to strip flavors, while wine producers are usually looking for more subtle effects. Let's look at how I developed three different booze-washing techniques—milk washing, egg washing, and chitosan/gellan washing—and how they can help you.

Milk Washing: What's Old Is What's New

I must point out that adding milk to alcohol and then clarifying, as I did with the Arnold Palmer, is nothing new. Milk punch has been around since the seventeenth century. The difference between milk punch and my milk washing: milk washing is practiced on straight booze, not a cocktail, and it anticipates shaking to produce fantastic foam. Milk punches were not typically shaken. Over time, the whey in milk-washed booze degrades and loses its foaming power. It doesn't go bad, it just loses its awesomeness. Use milk-washed boozes within a week or so.

My tea drink from the beginning of the section came out so nicely that I put it on the menu at the bar. Here it is, on the following page.

MILK PUNCH

A traditional milk punch contains booze, milk, and other flavors. The milk is induced to curdle and the curds are strained out; after the straining you are left with a clear, stable beverage. Here is Benjamin Franklin's recipe from a letter he wrote in 1763:

> Take 6 quarts of Brandy, and the Rinds of 44 Lemons pared very thin; Steep the Rinds in the Brandy 24 hours; then strain it off. Put to it 4 Quarts of Water, 4 large Nutmegs grated, 2 quarts of Lemon Juice, 2 pound of double refined Sugar. When the Sugar is dissolv'd, boil 3 Quarts of Milk and put to the rest hot as you take it off the Fire, and stir it about. Let it stand two Hours; then run it thro' a Jelly-bag till it is clear; then bottle it off.*

Why make milk punch? Milk punches are known for their soft, round flavors. That softness isn't caused just by the presence of milk but by the removal of phenolic compounds from the brandy via the casein-rich curds. Old Ben Franklin might have been dealing with some pretty rough brandy back in 1763, and the milk would have stripped away a lot of its harshness. Ben didn't mention the awesome foaming properties, because at that time no one was shaking cocktails with ice. Pity!

*Courtesy Bowdin and Temple Papers, in the Winthrop Family Papers, Massachusetts Historical Society

Tea Time (an alcoholic Arnold Palmer variant)

I use a Selimbong second-flush Darjeeling tea for this drink. Darjeeling is a famous tea-growing district in the mountainous northeast of India. In March the teas of Darjeeling grow their first crop of leaves—the first-flush Darjeelings. The first-flush teas are the most expensive, but they aren't my favorite. Several months later there's a second flush of new leaves. These second-flush Darjeelings are unique in the tea world for their fruity aroma, known in the biz as muscatel. Selimbong Estate is particularly well known for the quality of its second-flush teas. I infuse it into vodka because I want to highlight the tea rather than the intrinsic flavor of a spirit. Originally I made this cocktail with lemon juice and simple syrup. Piper Kristensen, who works with me at Booker and Dax, suggested that I use honey syrup instead, and he was right, not only because tea, lemon, and honey are a classic combination but because proteins in honey augment the foaminess of the milk-washed tea vodka. The honey syrup recipe is easy: add 200 grams of water to every 300 grams of honey (for ounce people: 10¼ ounces of water per pound of honey). Note that this recipe is by weight, not volume.

INGREDIENTS FOR THE TEA VODKA

32 grams Selimbong second-flush Darjeeling tea

1 liter vodka (40% alcohol by volume)

250 ml whole milk

15 grams 15% citric acid solution or a fat 1 ounce (33 ml) freshly strained lemon juice

PROCEDURE

Add the tea to the vodka in a closed container and shake it up. Let the tea infuse for 20 to 40 minutes, shaking occasionally. The time will change based on the size of the leaves you use and the type of tea you use if you don't use the Selimbong; what's important is the color, which provides a decent indicator of brew strength in tea. Go dark. When the tea is dark enough, strain it from the vodka.

Put the milk into a container and stir the tea vodka into the milk (note that if you add the milk to the tea vodka instead, the milk will instantly curdle and reduce the effectiveness of the wash). Let the mix rest for a couple of minutes, then stir in the citric acid solution. If you don't want to buy citric acid, use lemon juice, but don't add all the lemon juice at once; do it by thirds. When the milk breaks, stop adding. Don't stir too violently after you add the acid. Once the milk breaks, you don't want to reemulsify or break up the curds at all, or you'll make straining more difficult.

After the milk breaks, you will see small clouds of tan curds floating in a sea of almost clear tea-colored vodka. If you look closely, you'll see that the vodka is still faintly cloudy. It still has some casein in it that hasn't agglomerated onto the curds. Take a spoon and gently move the curds around to mop up the extra casein. You should see the vodka get noticeably clearer, and the curds will get noticeably more distinct. Do the gentle curd-mopping several times, then let the vodka sit undisturbed for several hours to settle out before you strain the curds with a fine filter and a coffee filter (or just spin the stuff in a centrifuge right away, as I do).

When you make your tea infusion, make it dark. Don’t worry about over-steeping, you will strip out the astringency later.

INGREDIENTS FOR TEA TIME

MAKES 1 4$\frac{3}{5}$ OUNCE (137 ML) DRINK AT 14.9% ALCOHOL BY VOLUME, 6.9 G/100 ML SUGAR, 0.66% ACID

2 ounces (60 ml) milk-washed tea-infused vodka

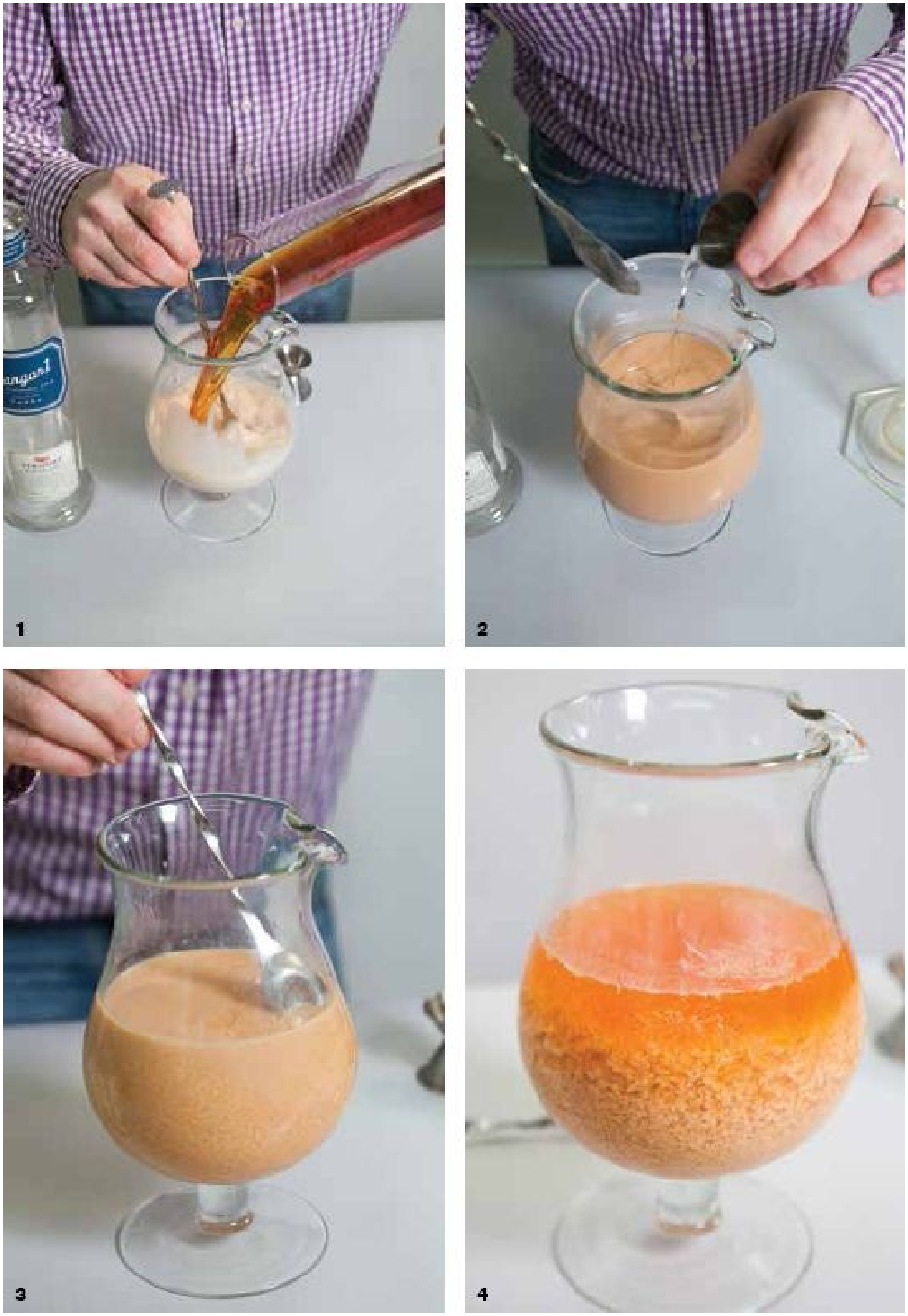
$\frac{1}{2}$ ounce (15 ml) honey syrup

$\frac{1}{2}$ ounce (15 ml) freshly strained lemon juice

2 drops saline solution or a pinch of salt

PROCEDURE

Combine all the ingredients, shake with ice, and serve in a chilled coupe glass. Garnish with pride in a job well done.



MILK WASHING: 1) *Always add the liquor to the milk, not the other way around, or the milk will instantly curdle. Some liquors—like coffee infusions—will break on their own. Others—like the tea shown here—will not.* ***2)*** *Stir the liquor to get it moving then add a bit of citric acid solution or lemon juice. In* ***(3)*** *the milk has just started to break. Gently agitate the liquor with a spoon to allow the curds to mop up any errant cloudy particles and* ***4)*** *allow the liquor to settle before coffee-filtering or centrifuging.*

All milk washing follows this procedure, but some liquors will curdle the milk even if you don't add any acid. In coffee infusions, the combination of alcohol and coffee is usually enough to curdle the milk on its own; ditto with cranberry-infused liquor. Whenever you milk wash, follow the tips above, like making sure to add the liquor to the milk, not the other way around, and gently stirring the curds to mop up all the free casein, and you'll get good consistent results.

Most of the time when I'm milk washing, I'm focused on very astringent ingredients such as tea. I have tested milk washing on less astringent polyphenol-rich aged spirits such as bourbon and rye and brandy. In these spirits, the oak in concert with the alcohol typically curdles the milk by itself. The oak in aged spirits not only destabilizes milk by adding polyphenols that bind to casein, it also reduces the pH to around 4 or 4.5, making the milk break more easily. Unfortunately, the milk washing really, really strips the oak flavor and color. Way too much, in my opinion.

You can milk-wash spirits without polyphenols, not to remove flavors but just to get the textural effects. Robby Nelson, a former bar manager at Booker and Dax, made daiquiris with milk-washed white rum, and were they good! I use milk-washed white rum to make an orange Julius variant called the Dr. J, which makes use of typical daiquiri specs (2 ounces rum, ¾ ounce lime juice, flat ¾ ounce simple syrup, pinch salt) but replaces the lime juice with lime-strength orange juice (add 32 grams of citric acid and 20 grams of malic acid to a liter of orange juice; see the Ingredients section, here, for details) and adds a drop of vanilla extract.

Egg Washing

After I tackled the problem of creating tea cocktails with milk washing, I remembered an unwashed tea cocktail that I really liked: the Earl Grey MarTEAni that my friend Audrey Saunders developed at Pegu Club, one of my favorite NYC bars. It's a mixture of Earl Grey–infused gin (Earl Grey is a blended tea flavored with bergamot citrus rind), lemon juice, simple syrup, and an egg white, with a lemon twist. I had always figured that the egg white in the MarTEAni was there for texture, but now I realized that the cocktail *needed* the egg white to bind with the tea's polyphenols and mellow the astringency. I asked Audrey about it and she said, "Of course—that's why the egg white is there." Duh! Then I got to thinking some more. Why is a whiskey sour shaken with an egg white while other shaken sours with similar sugar:acid:booze ratios (like the margarita, the daiquiri, and the fresh-lime gimlet) are not? It's the whiskey! The egg white in a whiskey sour is mellowing out what would otherwise be too astringent a drink at the temperatures and dilutions a whiskey sour achieves. I decided to give egg washing a try on its own, without making a cocktail.

A whole egg white represents a substantial portion of the liquid in the undiluted cocktail. A large egg white, roughly 30 milliliters, can represent a quarter of the total liquid before dilution—a 3:1 ratio of cocktail mix to egg white. I figured I'd try slightly less egg white, aiming for an egg wash at a ratio of 4 parts booze to 1 part egg white. I chose bourbon whiskey for my test. I mixed the egg white with a fork and stirred the whiskey into the egg, the same way that I stir booze into milk for milk washing. The egg quickly coagulated hard and was easy to filter out, but all that egg obliterated the flavor and color of the booze, rendering it like weakly flavored vodka. In an egg-white cocktail, the egg white stays in the drink, so the flavor isn't completely stripped. In egg washing, all that protein is removed, so the stripping effect is starker. I tried 8:1. Better, but still too stripped and a bit out of balance—the spiciness of the bourbon was gone. I then tried 20:1 and 40:1. The winner: 20:1 booze to egg white! This ratio left the character of the whiskey unharmed and allowed for a balanced drink. The procedure was simple and foolproof.

Note that this 20:1 ratio is designed to wash pure aged booze. If you want a harsher stripping effect, as you might for coffee or tea liquor, you'll be better off with a 8:1 ratio, or even a little higher. Those higher egg ratios will give you stripping power similar to milk washing. But remember that milk washing adds foaming power; egg washing does not. For a stirred tea cocktail, use an egg wash. For a shaken drink, go with milk and take advantage of the awesome texture.

Egg-Washing Technique

INGREDIENTS

1 extra-large egg white (after removing the yolk and losing the stuff stuck in the shell, this is about 32 grams, a little less than the 37 needed for a true 20:1)

1 ounce (30 ml) filtered water

750 ml liquor of your choice at 40% alcohol by volume or higher (lower-proof liquors don't coagulate the egg as hard, and once the alcohol

content goes below around 22% alcohol by volume the egg won’t coagulate at all)

PROCEDURE

Mix the egg white and water together to combine, and then add the liquor to the mixture while stirring. Note that the water is just there to increase the volume of the egg mix. A single egg white would be difficult to add liquor to without insta-curdle effects. If you are using an 8:1 or higher booze-to-egg ratio, you can omit the water. After you add the liquor, the egg white should break pretty quickly. Let the mixture sit for a couple of minutes and gently stir it to swab any stray proteins into the coagulum. Let the mixture stand for an hour, then strain it through a coffee filter. It should be clear.

***EGG WASHING, IN THIS CASE WITH BLENDED SCOTCH:* (1)** *Add liquor to the egg-white and water mix while stirring. In* **(2)** *the egg is just beginning to coagulate. With some gentle stirring it should look like* **(3)** *and should eventually settle like* **(4)**. **(5)** *Strain through a coffee filter. In* **(6)** *you see untreated liquor on the left and egg-washed liquor on the right.*

One of the fantastic things about egg washing is that you need no equipment, and unless you are vegan, you probably have eggs in your fridge right now. Also, because egg washing leaves very little residual protein in the liquor, you can use it to mellow drinks that are too harsh to carbonate on their own, and you can carbonate them without too much foaming. Milk washing will never work for a carbonated drink because it exacerbates the foaming issue.

Here is a recipe for an egg-washed red wine and cognac carbonated cocktail! That is a drink that needs some mellowing.

Cognac and Cabernet

If you set out to mix a red wine with a spirit like Cognac, you might choose a sweet wine—one that would mask the tannins present in both. But here we will stay dry, and strip the tannins out instead. This cocktail is deep pink, dry, raisiny, and satisfying. It drinks less like a cocktail and more like a wine. To do the booze washing you'll use 1 part egg to 6 parts booze—a fairly large proportion.

MAKES TWO $4\frac{4}{5}$-OUNCE (145-ML) DRINKS AT 14.5% ALCOHOL BY VOLUME, 3.4 G/100 ML SUGAR, 0.54% ACID

INGREDIENTS

1 large egg white (1 ounce/ 30 ml)

2 ounces (60 ml) Cognac (41% alcohol by volume)

4 ounces (120 ml) cabernet sauvignon (14.5% alcohol by volume)

2 ounces (60 ml) filtered water

$\frac{1}{2}$ ounce (15 ml) clarified lemon juice or 6% citric acid solution

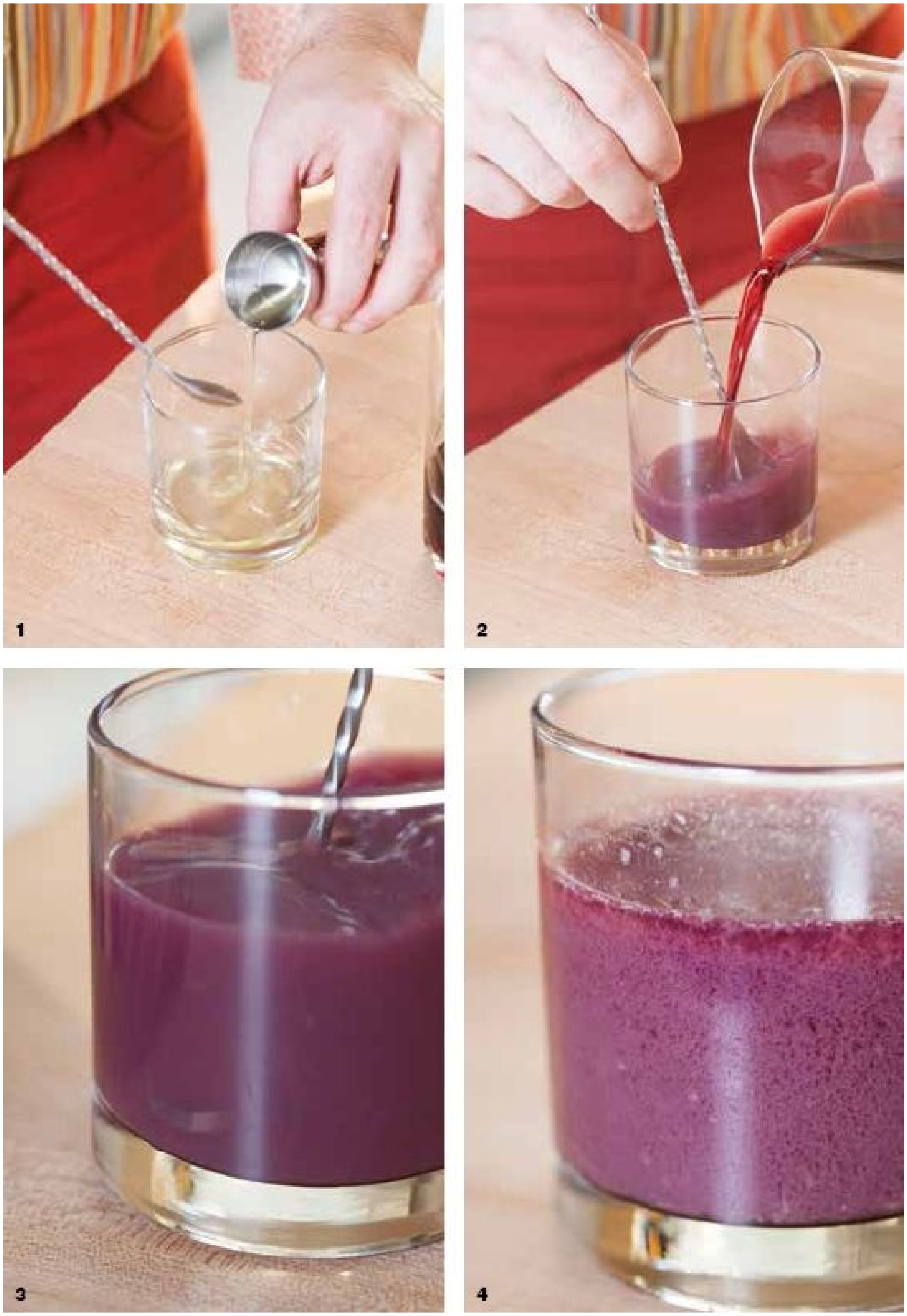
$\frac{1}{2}$ ounce (15 ml) simple syrup

4 drops saline solution or a generous pinch of salt

PROCEDURE

Add the egg white to a small mixing container and thoroughly break it up with a bar spoon. Combine the cognac and the cabernet and add them, stirring, to the bar spoon. Combine the cognac and the cabernet and add them, stirring, to the egg white. The mix should go cloudy. Continue to stir the mix slowly, making sure that all of the egg white comes into contact with the liquor. You should see wisps of denatured egg white throughout the mix. If you have a centrifuge, you can spin the mix now and collect the clear washed booze. Alternatively, let the mix sit for several minutes and then stir again. Allow the mix to settle for several hours and strain it first through a cloth napkin and then through a coffee filter.

When you have a clear liquid, add the water, lemon juice or citric acid, simple syrup and saline solution or salt. Chill the mix down to –6° C (20° F) and carbonate with the method of your choice (see the Carbonation section, here). Note: you’ll have some residual egg protein in this drink, so it will foam quite a bit when you carbonate.



EGG WASHING THE CABERNET AND COGNAC: *This recipe uses much more egg than regular egg washing;* ***1)*** *add no water to the egg.* ***2)*** *Pour the cabernet and cognac into the egg while stirring.* ***3)*** *It will look momentarily chalky,* ***4)*** *then break. Stir to mop up the cloudy bits and allow to settle before coffee filtering.*

I’ve figured out an even better technique for mellowing aged liquors that don’t require too much stripping prior to carbonation, but it calls for some specialty ingredients: chitosan and gellan. Keep reading, or skip ahead to the Carbonated Whiskey Sour, here, and use egg-washed whiskey to make it.

Chitosan/Gellan Washing

When I began clarifying apple juice years ago, I really wanted to make a refreshing carbonated apple cocktail with bourbon, but the oak flavors dominated the apple and became unpleasantly harsh. My solution at the time was to redistill the bourbon with a rotary evaporator. Unlike a typical still, the rotary evaporator can distill at low temperatures and recover almost 100 percent of the volatile flavors that get boiled off during the distillation process. I would split the bourbon into two parts: a clear liquid containing all the alcohol plus the aromas from the oak and the base spirit, and a dark opaque liquid with all the nonvolatile oak extractives that were messing with my carbonated drink. Since unaged clear bourbon is known as white dog, I called my redistilled clear bourbon gray dog—and it is pretty darn good, even on its own. I used the leftover oak extractives to make a great ice cream. Efficiency!

Now, redistillation has some problems. First, the equipment is expensive and there’s a pretty steep learning curve. Second, and more important, it is illegal to distill liquor without a license here in the United States, and a bar can’t ever get that license. Distilling at the bar puts the liquor license in jeopardy, which, once I owned a bar, I could not abide. After I began booze washing, I experimented with combinations of washing ingredients that would produce an aged whiskey or brandy that could be carbonated well, was foolproof, and removed only the flavors that scratch the back of my throat when I drink carbonated unmodified whiskey. I finally settled on a two-step (and fully legal) process using chitosan and gellan gum.

If you’ve read the section on carbonation, you’ve met chitosan, one of the magic wine fining agents that I use to clarify lime juice in the centrifuge. Chitosan is a long-chain polysaccharide (sugar) with a positive charge, commercially produced from the shells of shrimp, but it does not cause reactions in people with shellfish allergies. You can get it in liquid-solution form at any home winemaking shop. Unfortunately, the chitosan on the market today is not vegetarian, but that will change. As I write, vegan-friendly fungal chitosan is available in Europe. Chitosan, as a positively charged molecule, is going to attract the negatively charged oak polyphenols in whiskeys and brandies. The problem is, now you have to remove the chitosan. For that I use gellan.

Gellan is a gelling agent derived from microbial fermentation and is primarily used in cooking. Gellan has a lot of interesting properties. It can form fluids that, when standing still, can act like gels to make drinks with suspended solid particles (note: I don’t like this application for cocktails). It can form any texture, from soft and elastic to hard and brittle. It is heatproof. But none of these cool properties are important for us here. Despite what the manufacturers planned, we aren’t going to use gellan to make a gel at all. For booze washing, all we are concerned with is gellan’s negative charge, which makes it attract the chitosan; and its insolubility in booze, which makes it easy to filter out. There are two types of gellan: low-acyl gellan, aka Kelcogel F, and high-acyl gellan, aka Kelcogel LT100, both made by the CP Kelco corporation. Typically the Kelcogel F makes hard, brittle gels and the high-acyl gellan makes soft, elastic gels. For booze washing you should use the Kelcogel F, because unlike the high-acyl variety, it doesn’t swell in water at all and cause us to lose precious, precious booze. The names are random and confusing, but there’s nothing we can do about that. Just remember: Kelcogel F low-acyl gellan.

Original blended Scotch on left, chitosan-gellan washed Scotch in the middle and egg-washed Scotch on right. Note the different stripping intensity of the two techniques.

Chitosan/Gellan Washing Technique

15 grams liquid chitosan solution (2% of the booze amount)

750 ml booze to wash

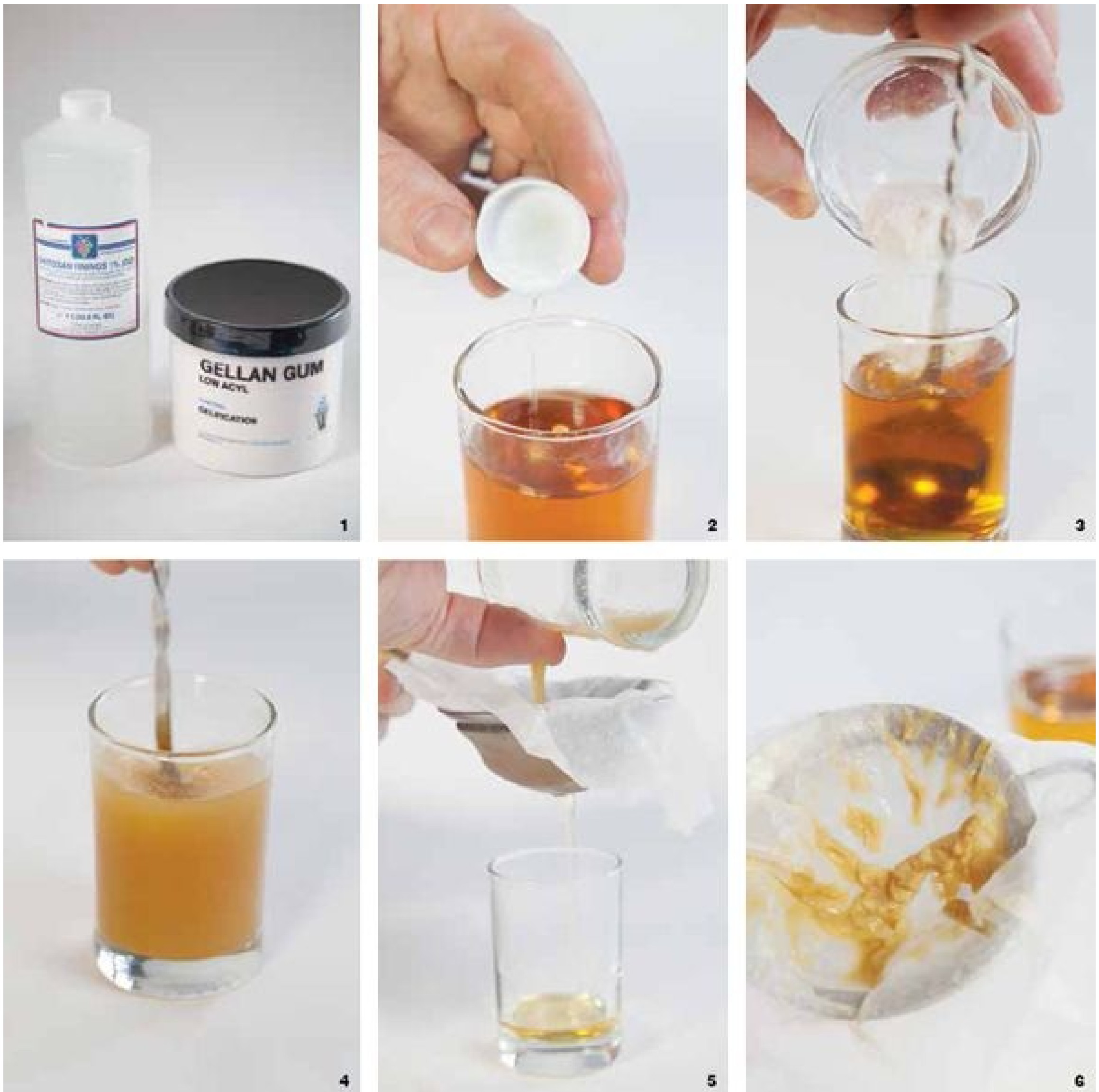
15 grams Kelcogel F low-acyl gellan (2% of the booze amount)

PROCEDURE

Add the chitosan to the booze and shake or stir to combine. Allow to rest for an hour, agitating periodically. Add the gellan to the booze and shake or stir to suspend the gellan. Resuspend the gellan in the booze every 15 to 30 minutes and allow the gellan to remain with the booze for 2 hours, then strain the liquor through a coffee filter. You are done.

NOTES: This recipe uses 2 percent chitosan. That's a lot of chitosan. For comparison, I use 0.2 percent in clarification—an order of magnitude less. I tested the recipe using less chitosan, and strangely, using less chitosan seemed to strip the liquor *more*. Yeah, I don't get it either, but it is hard to argue with empirical data. Two percent gellan is also *a lot* of gellan to use, much more than is used to make a gellan gel (0.5 percent low-acyl gellan makes a hard gel). The reason I use so much is that I'm using only the surface of the gellan powder. The vast majority of the gellan is on the inside of the granules and is useless to us. I could use less gellan if I used a finer particle size, but finer gellan isn't readily available.

Speaking of surface area, remember from the wine fining discussion that adsorptive flavor-stripping ingredients such as activated charcoal work by having tremendous surface area in which flavor molecules can get trapped. I wondered how much flavor-stripping gellan would do on its own owing to surface area effects, so I tested just gellan, without the chitosan. It did strip out some flavor, but not too much.



CHITOSAN-GELLAN WASHING:* *1) *Once you have the ingredients, this technique is preposterously easy and the yield is high.* ***2)*** *Add chitosan to liquor. Stir and let sit for an hour.* ***3 and 4)*** *Add the gellan and stir. Stir and let settle a couple more times over the course of 2 hours, then* ***5)*** *strain through a coffee filter.* ***6)*** *Look at the leftover gellan. All that color is the stuff you stripped out.*

Carbonated Whiskey Sour

Here is a simple carbonated drink to test booze washing. If you don't want to use chitosan/gellan washing, you can use egg washing instead. If you haven't already, read the Carbonation section for carbonation technique (here).

MAKES ONE $5\frac{2}{5}$-OUNCE (162.5-ML) DRINK AT 15.2% ALCOHOL BY VOLUME, 7.2 G/100 ML SUGAR, 0.44% ACID

INGREDIENTS

$2\frac{5}{8}$ ounces (79 ml) filtered water

$1\frac{3}{4}$ ounces (52.5 ml) chitosan/gellan washed bourbon (47% alcohol by volume)

5/8 ounce (19 ml) simple syrup

2 drops saline solution or a pinch of salt

Short $\frac{1}{2}$ ounce (12 ml) clarified lemon juice (or add the same amount of unclarified lemon juice after you carbonate)

PROCEDURE

Combine everything (except the lemon juice if it isn't clarified), chill to 14°F (–10°C), and carbonate with whatever system you choose.

What I've presented here on booze washing only scratches the surface of the possible. There's lots more for you to discover on your own. But, as I promised at the beginning of the section, I will move on to a bit on fat washing, a technique for washing flavor *into* (instead of out of) booze.

A Short Word on Fat Washing

Fat washing is simple. Anyone can do it. Pick a flavorful fat or oil. Common choices are butter, bacon fat, olive oil, peanut butter, sesame oil—whatever. Whatever fat you choose, make sure it tastes good. Just because you like bacon doesn't mean all bacon fat is good—properly rendered bacon fat is delicious; fat from overcooked bacon is gross. Butter that has been unwrapped in your fridge is gross. Your fat needs to be fresh and delicious. Next, ask yourself how strong your fat is. Smoky bacon fat is strong in flavor; butter is more delicate. With stronger-flavored fats, use a ratio of around 120 grams (4 ounces) of fat per 750 ml of liquor. With butter I use closer to 240 grams (8 ounces) per 750 ml.

If your fat is a solid at room temperature, melt it. If not, move on.

Add the fat to your liquor in a wide-mouth container, close it, and shake the container (you shake to increase the surface area where the liquor contacts the fat). The wide-mouth container will make it easier for you to get the liquor separated from the fat later on. Let the liquor rest an hour or so, agitating every once in a while for the first half hour, and then proceed to the next step.

Most of the fatty stuff should have floated to the top by now. Place the container of liquor and fat in the freezer. Most fats will form a nice puck at the top after a couple of hours in the freezer; just poke a hole in the fat puck, pour the clear, flavored liquor through a coffee filter into a bottle, and you are done. If your fat will not solidify (olive oil won't, for example), you can use a gravy separator or a separatory funnel (that's what I use) to separate the fat from the liquor.

Fat washing is a great technique, but I don't use it very often, because some of my good friends—Sam Mason and Eben Freeman, formerly of Tailor; Tona Palomino, formerly of wd~50; and Don Lee, formerly of PDT—were its real pioneers, so I leave it to them.

FAT WASHING GIN WITH OLIVE OIL IN A SEPARATORY FUNNEL (SEP FUNNEL): 1) *Combine gin and olive oil in the funnel and cover tightly.* ***2 and 3)*** *Shake violently to combine. Do this several times, a few minutes apart, and* ***4)*** *allow to settle. The beauty of the sep funnel:* ***5)*** *it allows you to drain the heavier liquid booze off the bottom without disturbing the liquid fat on top.* ***6)*** *The steep conical shape of the sep funnel encourages settling and allows you to get almost every drop of gin separated from the oil.*

Peanut Butter and Jelly with a Baseball Bat

In 2007 Tona Palomino, who ran the bar program at the famed restaurant wd~50 at the time, made a carbonated peanut butter and jelly cocktail called the Old-School. Because he was carbonating, Tona went to great pains to keep the liquor clear. We don’t have to worry about that because we are going to make a shaken cocktail. If you want clear liquor that you can carbonate, you’ll have to do what Tona did: spread a thin layer of peanut butter on the bottom of a hotel pan and then pour a thin layer of booze over the top and let it sit covered in a fridge for days.

PEANUT BUTTER AND JELLY VODKA INGREDIENTS

25 ounces (750 ml) vodka (40% alcohol by volume)

120 grams creamy peanut butter

125–200 grams Concord grape jelly

PROCEDURE

Thoroughly mix the vodka and peanut butter. Put the mix in a covered container and place it in the freezer for several hours to settle out. If you have a centrifuge, spin the mix; you should have a yield of around 85 percent (635 ml). If you don’t have a ’fuge, pour the mix through a cloth napkin to remove the big particles and then pass the strained liquid through a coffee filter. The coffee filter will clog frequently, so you’ll need to use several. The booze should be clearish. Using the napkin-and-coffee filter method, you should get a yield between 60 and 70 percent (450–525 ml). Don’t use expensive vodka! Add a shade over 30 grams (a heavy ounce) of grape jelly to every 100 ml of peanut butter vodka and shake or blend to combine. Strain the mix to get rid of any stray jelly particles, and you’re done.

***MAKING THE PEANUT BUTTER VODKA:* 1)** *The vodka and peanut butter have settled in the freezer for several hours. Either centrifuge them, or* **2)** *strain first through a cloth,* **3)** *then through a coffee filter.*

MAKES ONE $4\frac{7}{10}$ OUNCE (140 ML) DRINK AT 17.3% ALCOHOL BY VOLUME, 9.0 G/100 ML SUGAR, 0.77% ACID

PB&J WITH A BASEBALL BAT INGREDIENTS

$2\frac{1}{2}$ ounces (75 ml) Peanut Butter and Jelly Vodka (32.5% alcohol by volume)

$\frac{1}{2}$ ounce (15 ml) freshly strained lime juice

2 drops saline solution of a pinch of salt

PROCEDURE

Combine the ingredients in a cocktail shaker with copious ice and shake for just 6 seconds. Don’t overshake; this drink is not good when overdiluted. Strain into a chilled coupe glass and enjoy.

PEANUT BUTTER AND JELLY WITH A BASEBALL BAT

Carbonation

Carbon dioxide gas (CO_2) gives bubbly drinks their distinctive taste. The taste of carbonation is difficult to describe. I call it prickly, but that doesn't get it quite right. Carbonation is hard to describe because, as was recently discovered, we have specific elements in our mouths that sense CO_2. In other words, carbonation is an actual taste, like salty and sour. You'd be hard-pressed to describe those tastes as well. Current research indicates that our carbonation sense is related to our sense of sour, but carbonation doesn't taste acidic. People used to think that the sensation of carbonation was due to pain in the mouth caused by the acidity of carbonic acid (formed when CO_2 dissolves in water) combined with the mechanical action of the bursting bubbles. Clearly not true. You can make bubbly drinks with nitrous oxide (N_2O), aka laughing gas, but because N_2O tastes sweet instead of prickly, the drink won't taste carbonated, even if you add acid to the drink. Carbonation is an ingredient, like salt or sugar.

Carbonated drinks are supersaturated with CO_2, meaning that they have more gas in them than they can permanently hold—that's why they bubble. The more CO_2 a drink contains, the sharper the carbonation tastes. Controlling that sharpness is the art of carbonation.

Using premade bubbly mixers cedes cocktail bubble control to the mixer, which isn't a good thing. Most commercial mixers are low quality. Even good mixers can deliver only meager bubbles to a finished cocktail once they've been diluted by alcohol and melted ice. Put simply, if you want bubbles done right, you'll have to carbonate your cocktails yourself.

BUBBLE PHILOSOPHY

I grew up drinking bubbly water, and it has been my primary form of hydration for decades. Flat water is, well, flat by comparison. When I ask for sparkling water, I want the throat-ripping experience of copious carbonation. I believe this is a very American preference, and I'm suspicious of any native son or daughter who prefers lightly carbonated water. But not all drinks benefit from maximum carbonation. Some effervescent cocktails taste good with puny bubbles.

Carbonation is an ingredient, and too much is as bad as too little. Many American sparkling wines, for instance, are overcarbonated and taste better after they sit for a while. Overcarbonation can destroy the nuance of fruit flavors, overemphasize oaky and tannic flavors, and add a harsh carbon dioxide bite.

The goal of carbonation is to *control* the bubbles in your drink. You should be able to conjure up the exact level of carbonation that you desire. While there has been a recent proliferation of relatively inexpensive and easy-to-use equipment offering wide access to carbonation, most carbonation technique at the bar remains poor. Carbonating water is fairly easy; even subpar equipment and lax technique can produce decent sparkling water, so people are lulled into thinking the same carelessness will suffice when they move on to carbonated cocktails. Not so. Only great care and perfect technique can achieve good carbonation in an alcoholic beverage. If you understand how carbonation works, you can hone your carbonation technique and achieve good results even with suboptimal equipment. So before we get into specific carbonation techniques, a word on how bubbles work. Expect detail and minutiae. If you have no patience, you can skip to Carbonation in a Nutshell, here.

BUBBLES 101

The amount of CO_2 that a bottled drink contains is primarily a function of two parameters, temperature and pressure (well, okay, it is also a function of the ratio of headspace to liquid, but we can safely ignore that variable). The higher the pressure in the bottle, the more CO_2 the drink will contain. More accurately, the higher the pressure of CO_2 in the headspace above the drink, the more CO_2 the drink will contain (in chemistry this fact is known as Henry's law). If the pressure in the headspace comes from regular air as well as CO_2, there will be less CO_2 dissolved in the drink—one of the reasons that air is an enemy of good carbonation.

At a given pressure, the amount of CO_2 a liquid can hold increases as it gets colder. In a sealed bottle the amount of CO_2 can't change, so as the temperature goes up, so does the pressure, and as the temperature goes down, so does the pressure. The two are tied together.

How fast the CO_2 gets into your drink is a different story. Simply applying CO_2 to the empty space above a drink doesn't carbonate it very quickly at all, because the CO_2 can diffuse into the drink only through the relatively small surface area of the liquid at rest. Just as you chill a drink with ice by stirring or shaking to bring fresh cocktail in contact with fresh ice, you carbonate by radically increasing the fresh surface area that the drink shares with the CO_2. You can achieve this by shaking the drink under pressure, or by injecting large amounts of tiny CO_2 bubbles into the drink, or by spraying the drink as a mist into a pressurized container of CO_2. I don't care how you do it—just up the surface area.

LE CHÂTELIER

Strangely, the reason the solubility of CO_2 goes up as temperature goes down is that CO_2 releases energy when it dissolves in liquid; the reaction is exothermic. In fact, the heat from dissolving CO_2 in a highly carbonated drink can raise its temperature by over 5°C!

> My assumptions: dissolution enthalpy of CO_2 = 563 calories per gram. carbonation level = 10 grams per liter, beverage = pure water

The temperature rise is a rarely considered consequence of carbonation, but it is the reason we can apply one of the fundamental principles of chemistry, Le Châtelier's principle. Named after the French chemist Henry Louis Le Châtelier, Le Châtelier's principle states that if you push a chemical system away from equilibrium, that system will tend to push back toward equilibrium. If you have bubbly water and CO_2 at a given temperature and you remove heat from the system by making the bubbly water colder, Le Châtelier's principle says that the system will react by trying to make more heat. How? By making more CO_2 dissolve. True? Yes. Intuitive? No.

TINY BUBBLES

Many people think they want tiny bubbles. They think tiny bubbles are a hallmark of quality. The singer Don Ho immortalized those "Tiny Bubbles in the Wine" and set the consuming public on a seemingly inexorable path toward bubble prejudice. But let's look at how bubble size is determined. In a highly carbonated drink, more CO_2 rushes into the bubbles at any given time, making bigger bubbles. Similarly, the warmer a drink is, the more CO_2 tries to leave, making larger bubbles. Last, the taller you pour a drink, the larger the bubbles become, because they have longer to live and grow from where they form till they pop at the surface of the drink. None of these bubble-size factors are markers of quality.

The composition of the drink also influences bubble size. Different drinks—let's say a glass of champagne and a gin and tonic—carbonated to the same level and served at the same temperature in the same kind of glass will have different bubble sizes. The ingredients of a drink affect how easily bubbles are formed, how fast they grow, and how much CO_2 wants to leave. Even among fairly similar liquids, like different white wines, the grape variety and the amount of yeast breakdown products radically affect bubble size. Different bubble sizes in these cases are not hallmarks of quality but a function of drink composition.

So how did the tiny-equals-good mythical equation arise? An analysis of champagne aging helps. Young champagne has a lot of carbonation and fairly large bubbles. As champagne ages, CO_2 gradually diffuses through the cork, which is not a hermetic seal, and lowers the carbonation, producing tinier bubbles. So in champagne, weaker carbonation correlates with greater age. Since only fine vintage champagnes are typically aged very long, age and the tiny bubbles it brings denote quality. Additionally, recent research shows that as champagne ages, its composition changes, so that for a given level of CO_2, old champagne will have smaller bubbles. So in champagne, tiny bubbles correlate with age, which can often correlate with quality (we tend to age only fine champagne). Certainly the tiny bubbles aren't the cause of the quality. If I take a lousy sparkling wine and partially decarbonate it, I will end up with an equally lousy sparkling wine with tiny bubbles. If I take great vintage champagne and up the carbonation, it will still be great, but with bigger bubbles.

SABERING CHAMPAGNE AND OTHER BUBBLY WINES

While not really a carbonation technique, a section on bubbles seems the most apt place to describe sabering a bottle of champagne.

Many people feel that sabering sparkling wine is useless and wasteful. I disagree. Sabering expensive champagne is wasteful (if you make a mistake). Sabering a $7 cava is an exhilarating, awesome party trick. Whether a bottle will saber depends only on the bottle, not the price of the wine, so stick with the inexpensive.

Sabering is the art of cleanly knocking the top off a bottle of sparkling wine. You hit the lower lip of the top of the champagne bottle and snap off the top of the neck. Yes, you break the glass. No, the glass doesn't get into the drink, because the momentum carries it away from the neck. Sabering works because there is a ledge where the lip meets the neck. Stress concentrates at this ledge, making the bottle want to snap cleanly. You will get small shards of glass on the floor, so be careful. If you have young children, be doubly careful; I know from bitter experience that glass shards will find tiny feet the next morning. Obviously, saber away from any people and don't aim toward mirrors or closed windows. And don't saber over food, unless you're a glass-eating circus freak.

When you saber a bottle of bubbly, avoid swinging your knife in an arc. With confidence, swiftly and smoothly run the back of your knife squarely up the side seam of the bottle, strike the glass lip, and "punch" the glass collar and cork off of the bottle. This trick takes no strength—except strength of will. Don't hesitate or pull back.

THE PROCEDURE

Select a bottle that looks pretty standard. Don't pick one with a funky neck—sabering might not work. Superimportant tip: if you are sabering in front of a crowd you're looking to impress, select a bottle you *know* will saber. If you sabered a particular brand before (Paul Chenaux cava, for instance, or Gruet sparkling), odds are it will work again. If you have failed with a bottle before (Cristalino Cava), you will probably fail again. Embarrassing! A corollary to this tip: practice first to figure out which bottles will work.

Chill the bottle. Let it rest upright for a while before you saber it, and be gentle with the bottle before you saber. Warmer bottles are easier to saber but tend to gush. The best saber jobs don't gush at all (take that, anti-saber snobs). Don't take off the wire cage until you are ready, lest the cork come out on its own. Some people saber with the cage on, but I think it's more difficult.

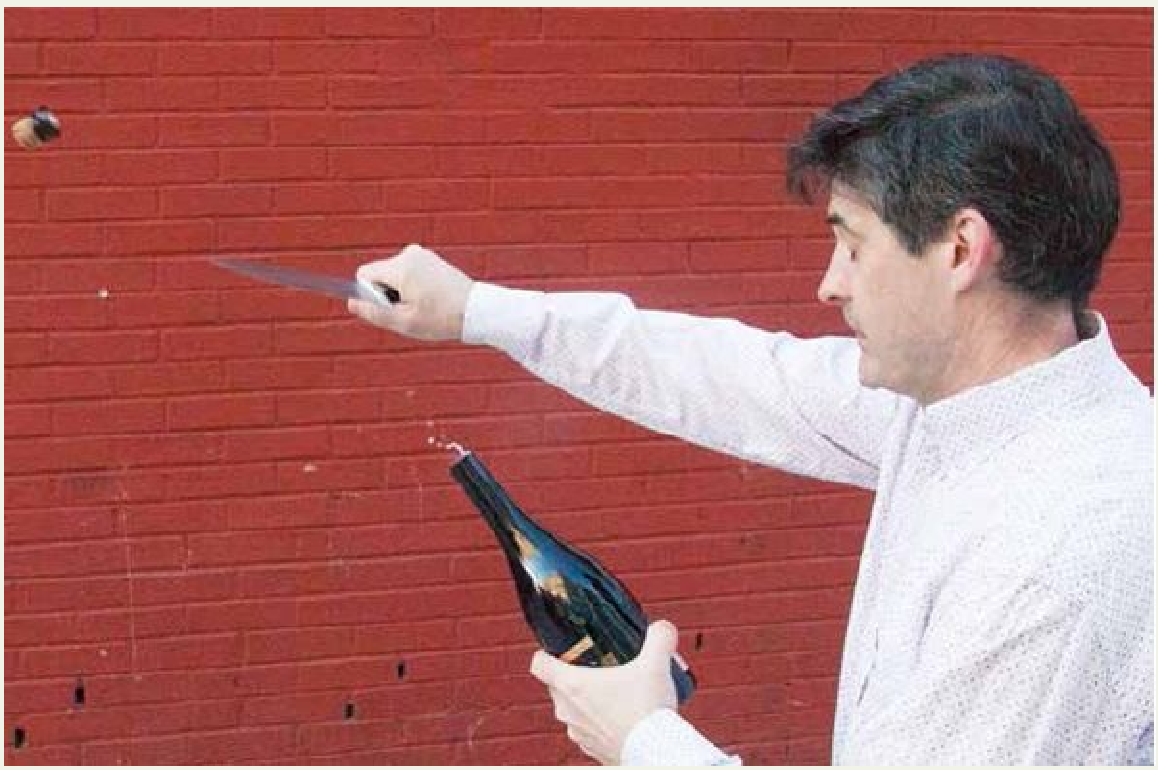
Get a knife. It doesn't need to be heavy. It doesn't need to be sharp. In fact, it doesn't even need to be a knife—I made a stainless steel ring for sabering at parties. You'll use the back (dull) side of the knife, not the sharp one. I saw a friend forget this rule one night and ruin her host's good chef's knife.

Find the seam running up the side of the bottle; this seam is a weak point and further concentrates the stress when you hit the lip. Angle the bottle away from you, your friends, any glass, and any food. Place the knife on the bottle’s seam at the bottom of the neck, making sure you keep the knife flat against the bottle. If you don’t, the knife has a tendency to pop over the lip of the bottle.

The moment of truth: slide the knife smoothly, surely, and SQUARELY up the neck of the bottle and sever the top. It doesn’t take force, just confidence. The biggest and most common mistake: swinging the knife in an arc. If you swing in an arc, even a small one, you won’t hit the glass in the right place and you won’t sever the neck. Mortifiying.

If it doesn’t work, try one more time, maybe two. Don’t try five or six times on the same bottle. Whacking away seems desperate. If the bottle doesn’t want to saber and you force it to, you might get a bad break, shattering the bottle completely.

Remember that the momentum carries all the glass shards away from the neck and your drink (that’s why I told you to hold it at an angle). Pour with confidence and enjoy.



Turns out I always blink during the money moment.

My Carbon Dioxide/Nitrous mixing rig. I took apart and modified a Smith gas mixer designed for mixing welding gases, converting it from a flow-based device to a pressure-based one that allows me to carbonate at any pressure up to 60 psi with any ratio of CO_2 to N_2O.

An alternative to the mixing rig: make premixed gas cylinders.

The quantity of CO_2 in a drink, not bubble size, is the most important carbonation characteristic. The amount of CO_2 escaping from the drink determines how rough and biting that drink will be and how the volatile aromas will be punched into the air above the glass to greet your nose. Sometimes I want to make extremely lively drinks with huge bubbles that effervesce massively on the tongue and eject a lot of aroma compounds toward your nose. If I were to create those drinks using only CO_2, they would sting your nose painfully as you tried to drink. Instead I make superbubbles with a gas mix. Remember that nitrous oxide (N_2O) is highly soluble in water and tastes not sharp but sweet. When I add a percentage of nitrous to my carbonated drinks, the result is big lively bubbles that aren't painful. The gas-mixing system is a bit involved, and unless you are a dentist, tanks of N_2O are hard to come by (people sometimes abuse it as a drug and die when they fall asleep with a nitrous mask on), so I won't tell you how to do it, but if you can decode what is going on from a picture of my rig, go for it.

HOW MUCH CO_2 IS IN MY DRINK?

When I quote carbonation levels, I use grams of CO_2 per liter of beverage (g/l). If you read technical soda literature, you'll notice that CO_2 is measured in an arcane unit called "volumes of CO_2." A volume of CO_2 equals 2 g/l of CO_2 (see the sidebar on volumes of CO_2, here). Your average cola contains about 7 g/l. Orange soda and root beer have less carbonation, typically around 5 g/l. Mixers such as tonic water, which are supposed to be watered down with booze, and seltzer water, which is supposed to rip your throat out with bubbly goodness, have much more carbonation—around 8 or 9 g/l. In nonalcoholic drinks, levels much above 9 g/l become painful. But with alcoholic drinks, it's a different story.

IMPORTANT CARBONATION PROPERTY OF ALCOHOL

CO_2 is more soluble in alcohol than in water, so less CO_2 escapes a boozy drink to hit your tongue. Because the sensation of carbonation depends on CO_2 leaving your drink and hitting your tongue, you need to put more CO_2 into an alcoholic drink to have it taste as carbonated as its nonalcoholic cousins. According to the literature, young champagne, which is 12.5 percent alcohol by volume, can have as much as 11.5 to 12 g/l of CO_2 dissolved in it. That much CO_2 in seltzer would be horrific. Frankly, it's too much CO_2 for champagne as well, but it won't rip your face off.

In general, **the more alcohol a drink contains, the more CO^2 you will need to add when carbonating**.

Measuring carbonation is a tricky business, and in practice I don't do it. I just carbonate my drinks at a constant temperature and pressure. If I don't like the results, I maintain the temperature and dial the pressure up or down. It is sometimes useful, however, to measure how much CO_2 you are putting into your drink. The easiest way to measure CO_2 is to weigh your drink before and after the carbonation procedure (with the cap off). The extra weight is the CO_2 you've dissolved into your drink. You should convert your answer to grams per liter.

HOW TO MEASURE THE AMOUNT OF CO_2 YOU ADD TO A DRINK: 1) *Weigh the uncarbonated liquid on a scale in the carbonator bottle without the cap.* ***2)*** *Carbonate.* ***3)*** *Weigh the bottle again with the cap off. The weight on the scale is the weight of added CO_2—in this case 4.3 grams into 500 ml. It's important that you remove the cap so that the scale does not register the weight of compressed CO_2 in the bottle.*

ANOTHER IMPORTANT CARBONATION PROPERTY OF ALCOHOL: CARBONATING RESPONSIBLY

Carbonated cocktails can get you majorly shellacked. CO_2 really helps to get ethanol into your bloodstream. That old saw about champagne going to your head is not a myth. Alcohol is absorbed mainly in your small intestine, not your stomach. The faster alcohol gets to your intestine, the faster you can absorb it and the faster, and higher, your blood alcohol content (BAC) can spike. The current wisdom is that the CO_2 in drinks helps speed gastric emptying into your small intestines, causing a rapid rise in BAC. Compounding the issue, people are accustomed to drinking carbonated drinks rather quickly, so they do, regardless of alcohol content.

The takeaway message here is to keep the alcohol levels of your carbonated drinks down. When I first started carbonating drinks, I regularly carbonated cocktails at shaken and stirred drink dilutions: 20 to 26 percent alcohol. People were on the floor in short order. This outcome was not my goal, and I'm sure it's not yours. Nowadays my carbonated cocktails average between 14 and 17 percent alcohol by volume. These drinks are more civilized and taste better. As you will see, drinks with less alcohol have better carbonation, last longer in the glass, and are less cloying than higher-alcohol versions.

THE PROBLEM OF FOAMING AND THE THREE C'S OF CARBONATION

CO_2 in the bottle is great, but it doesn't amount to a hill of beans if it never makes it to your tongue. What's important is the CO_2 your drink has in the glass. When you open a bottle of bubbly and pour a drink, you lose carbonation—maybe a lot of it. Gerard Liger-Belair, the champagne physicist (yes, that is a real job, and you are too late to get it), has studied the phenomenon of CO_2 loss in champagne quite closely. His studies show that uncorking a bottle of fridge-temperature champagne and pouring it carefully down the side of an inclined glass—the best-case pouring scenario—can lower the amount of CO_2 in the champagne from 11.5 grams per liter to 9.8 grams per liter. That loss is probably a good thing; 11.5 grams per liter is too intensely carbonated. Carelessly pouring that same champagne into the same glass reduces the carbonation to 8.4 grams per liter, my lower limit for good carbonation in a fresh glass of young champagne. If you open the same champagne when it's room temperature, you can knock a couple more grams per liter off those numbers. If you open a bottle carelessly and it gushes out the neck and over the side, the problem is much, much worse. Gushing, or fobbing as it is called in the soda business, can destroy precious carbonation lickety-split. In fact, foaming is carbonation's biggest enemy. Nine-tenths of good carbonation is foam control.

VOLUMES OF CO_2 for Ideal Gas Law Fans

In the 1800s an Italian dude named Avogadro figured out that at equal temperatures and pressures, equal volumes of gases contain the same number of molecules regardless of how much those molecules weigh: a deep insight. Remember that. In a related story, the chemistry community named an important number after Avogadro—Avogadro's number, which equals 6.022×10^{23}, which is mind-bogglingly huge. Avogadro's number is important because it helps us to shift between weights on an atomic scale and a macroscopic scale. Different kinds of atoms and molecules have different weights. Those weights are expressed in a relatively useless unit, the atomic mass unit (amu). Avogadro's number is the conversion factor between atomic mass units and grams. If you know that the mass of a single molecule of CO_2 is 44.01 amu, you know that 6.022×10^{23} CO_2 molecules weigh exactly 44.01 grams. Unfortunately, you also have to remember another unit, because a pile of CO_2 containing Avogadro's number of molecules isn't called an Avogadro of CO_2, it is called a mole. The mole is one of the most important units in chemistry—it allows you to work with ratios of actual molecules using grams.

Okay, so one mole of CO_2 has a mass of 44.01 grams and contains 6.023×10^{23} molecules. Back to Avogadro's original hypothesis: one mole of gas at standard temperature and pressure (hereinafter referred to as STP) will fill up the same volume regardless of how much that mole weighs. Ideal gas law fans will remember that the volume of one mole of gas at STP is 22.4 liters. So one mole of CO_2 at STP will occupy 22.4 liters and weigh 44.01 grams.

Finally we can come back to the arcane unit of carbonation: volumes of CO_2. One volume of CO_2 is defined as the mass of CO_2 gas, in grams, that would fill a particular volume, in liters, at STP. That is 44.01 grams divided by 22.4 liters: roughly 2 g/l. Sufficiently arcane?

CO_2 leaves a drink in two ways: directly from the surface of the drink and through bubbles. The first path is controlled by the glass. Roughly, the less surface area of drink is exposed per unit of volume, the less CO_2 you lose per unit of time. This is why champagne flutes and other tall glasses are good for carbonated drinks, and why you should fill them high if they are going to sit around for a while (more volume for the same exposed surface area).

Controlling how much CO_2 leaves in bubble form is more difficult. If you pour a perfectly clear carbonated liquid into a perfectly clean, perfectly smooth glass, you get no bubbles—none—because in a pure liquid it is extremely hard to form a bubble. Bubbles in bubbly drinks inflate the same way a balloon does. The pressure of CO_2 in the drink is higher than it is in the bubble, so the bubble blows up like a balloon. The surface tension of the liquid surrounding the bubble acts like the rubber in a balloon to resist inflation. Bubbles are also like balloons in that the smaller they are, the harder they are to blow up. There is a critical bubble radius—dependent on the liquid's surface tension and the pressure of CO_2 in the drink—below which any bubble formed will get crushed back to nothing. Any bubble larger than that critical radius will tend to grow. Surprisingly, you can't just raise the pressure to initiate bubbles. You'd need hundreds of times more CO_2 than you get in ordinary bubbly drinks to form spontaneous bubbles.

What you need to form bubbles are **nucleation sites**: anything in or touching a liquid that enables bubbles to form. Bubbles like to form on anything that is discontinuous or already contains trapped gas. In a glass, those nucleation sites can take the form of scratches or marks in the glass, or leftover minerals or schmutz from washing, or, most famously, leftover fibers from the towels used to dry and polish. In the drink itself, nucleation sites come from suspended particles, dissolved and trapped gas, or any currently existing bubbles. If you have too many nucleation sites, there are too many places where CO_2 can form and rush into bubbles, and you get gushing. Gushing loses tremendous amounts of CO_2. Even worse, nucleation sites keep nucleating for the life of the drink. Drinks with lots of nucleation sites lose lots of gas right away and continue to lose it faster than drinks with fewer nucleation sites.

The water on the left is highly carbonated. It is not bubbling at all because the glass has no nucleation sites—I analytically cleaned the glass so it was free of all residue. Drop a rock of sugar into the drink and it immediately starts bubbling.

You can't eliminate nucleation sites, but you can reduce them or limit the effect they have by following the three C's of carbonation: clarity, coldness, and composition.

C #1: CLARITY

If your drink isn't clear, it won't be easy to carbonate. I clarify everything I'm going to carbonate. Some commercially carbonated drinks are cloudy, such as Orangina, but notice that they have very light carbonation and no alcohol. Even adding small amounts of unclarified juice to a highly carbonated cocktail can cause major foaming. Notice that the flip side of clear isn't colored or dark, it's cloudy. Colored drinks are okay. Drinks that have so much color they appear opaque, like red wine and cola, are still okay to carbonate if they aren't cloudy when you hold them up to the light. The first duty of the carbonation maven is to clarify. To learn how, see the section on clarification (here). If you don't want to clarify, choose ingredients that are already clear. If you absolutely must use cloudy ingredients, use small amounts and add them at the end, after you have carbonated the bulk of your drink.

C #2: COLDNESS

Warm drinks bubble and foam violently when they are opened. Some people try to fix the foaming problem by jacking the pressure to add more gas. This won't work. Once a drink foams violently when it is opened, you have exceeded the level of CO_2 that the drink can viably hold. Increasing the pressure beyond that point will actually reduce the amount of CO_2 you get in the glass, because the foaming will get worse and worse. I have seen many people boost carbonation pressures higher and higher, only to find their drinks tasting flatter and flatter. Better to chill your drink properly first.

How cold should you chill? My rule of thumb is, as cold as possible: at, or just above, the freezing point of the beverage. The colder you get your drinks, the more CO_2 they can hold without foaming and the less carbonation you'll lose when you serve them. I carbonate water-based drinks at 0° Celsius. I carbonate most of my cocktails between –6°C and –10°C (21°F and 14°F). Very highly alcoholic drinks, such as carbonated straight shots, I carbonate at –20°C (–4°F).

If you chill your drink too much, it will start to freeze and form zillions of tiny ice crystals. Tiny ice crystals are fabulous nucleation sites. If you open a bottle with those crystals, you'll produce huge quantities of bubble-robbing foam. As long as the bottle is sealed, don't worry—you won't lose carbonation. Don't open the bottle until the ice crystals have melted. Once they melt, your drink will be in top form.

A last note on temperature: your carbonation will be more consistent if you maintain a constant temperature when you carbonate. If you try to carbonate at any old temperature, you will never get consistent results. Remember, as the temperature goes up or down, so does the pressure required to reach a particular level of carbonation.

C #3: COMPOSITION

A cold clarified drink can still foam because of its composition. We'll break the composition problem into three parts: suds, air, and alcohol.

Suds:

Some ingredients, even when totally clarified, foam like demons. Clarified milk whey, which I use in a lot of uncarbonated drinks, is full of protein, and protein loves to make foams. I always suspected that whey would pose problems, but other ingredients, like cucumber juice, surprise me with their foamy intransigence. In general, if ingredients have a large amount of protein, emulsifiers, or surfactants, or are viscous, you can plan on dealing with foam. A good way to know if you'll have problems is to shake some of your test ingredient in a clear container and observe the foam. Does it make a layer of foam on top? If it does, does the foam break down rapidly? The foamier and more persistent the suds are, the harder it will be to carbonate your ingredient. Other than avoiding such ingredients, your only option for controlling foam is to cover your other bases properly: clarify, chill, and carbonate carefully. I have tried using antifoaming agents like polydimethylsiloxane to help fix the foam problem. No luck. I'm kind of glad. Who wants to say they add polydimethylsiloxane to their cocktails?

Air:

As I've mentioned before, air is an enemy of carbonation. Besides taking up space in the bottle that is better used by CO_2, air causes foaming. Small amounts of air trapped on microscopic dust specks are major nucleation sites. In addition, the small amounts of air dissolved in the drink itself, and the small air bubbles formed when a drink is agitated, inflate when you open a carbonated drink and produce loads of annoying foam. Luckily, the solution is simple: carbonate more than once.

I'll say that again: to get good carbonation you must carbonate more than once. An illustration of the procedure will show why. Carbonate your drink. Open it right away and let it foam. Don't let it spray everywhere—that's messy and wasteful—but let it foam. At this point you *want* the drink to foam. As the drink foams, it forms large, quickly expanding CO_2 bubbles that carry with them a lot of the trapped air and other nonsense that was stuck in your drink. The CO_2 rushing out of your drink also pushes air out of the headspace. After the foam starts to settle, carbonate again and let it foam again. Notice that this time it foams a bit less (you hope). Carbonate again. This time let the drink settle before you ever so carefully and slowly release the pressure. After three rounds of carbonation you should have strong, stable, foam-resistant carbonation that lasts.

Alcohol:

Adding alcohol makes drinks more difficult to carbonate. Alcohol lowers surface tension and simultaneously increases viscosity—a double whammy. Lower surface tension means bubbles can form more easily. Higher viscosity means that bubbles don't dissipate quickly on the surface. The upshot is that alcohol makes drinks foam, even if you do everything else properly.

It gets worse. Remember that alcohol requires more CO_2 than water to get the same feeling of carbonation on your tongue, because CO_2 is more soluble in alcohol than in water. So when you add alcohol, you are in a real pickle. It automatically foams more than water, and you have to add more CO_2 to it than to water, increasing the foaming even more. Ouch. This is one reason I keep my carbonated drinks between 14 and 17 percent alcohol by volume. For another reason to keep the alcohol by volume down, see the sidebar on carbonating responsibly, here.

Last Word on Foam

Remember, no matter how good you are at carbonation, your drink will foam. If you don't want your drink spraying everywhere when you open it, you need to leave enough headspace in your carbonation vessel. Learn from my mistakes.

Here I break all the rules of foam prevention. I'm quickly opening a recently agitated, poorly clarified, too-warm alcoholic drink—with predictable results.

FINALLY! HOW TO ACTUALLY CARBONATE SOMETHING: EQUIPMENT AND TECHNIQUES

There are a million ways to skin the carbonation cat. I'll describe three. Hopefully you can adapt one of these techniques to whatever equipment you have. The systems I describe will certainly become outmoded, but the principles of carbonation and how they are applied are immutable.

TECHNIQUE ONE: BOTTLE, CAP, AND TANK

The easiest of the techniques: just use a special adapter to hook up a plastic soda bottle to a large-format CO_2 tank. This is the system I use at home and at the bar. It is simple, relatively cheap, and produces amazing results very predictably for pennies per drink.

THE HARDWARE

CO_2 TANK: I like this system because of the large tank and the regulator. Large CO_2 tanks, as opposed to cartridges or minibottles, are superior, because the gas is much cheaper and you'll make a whole lot of drinks before you run out. CO_2 tank sizes are measured by how many pounds of CO_2 the tank can safely hold. I use 20-pound tanks at home and at the bar, and 5-pounders when I do demonstrations on the go. A 20-pounder will just fit in a standard under-counter cabinet and will carbonate hundreds of gallons of water, wine, and cocktails.

You can rent a CO_2 tank from your local welding supply shop, but just buy one. As I am writing, a brand-new empty 20-pound CO_2 tank can be had for less than $100. The folks at your local welding shop (you have one; you just need to find it) will swap your empty tank for a full one and they'll just charge you for the gas. Depending on where you live, you will pay between $1 and $2 a pound for the gas. You need to chain or secure the tank in an upright position and keep it away from extreme heat. Before you use a tank you must familiarize yourself with basic CO_2 safety principles—not rocket science, but you need to study them. Check the Internet—a number of companies post advice.

CARBONATOR RIG: *On right, a standard soda bottle. In the center, a 5-pound* CO_2 *cylinder connected to a pressure regulator that can supply 120 psi of pressure. A gas hose comes out of the regulator and terminates in the gray ball-lock connector. In use, the red carbonator caps at left screw on the soda bottle and connect with the gray ball-lock connector.*

REGULATOR: Your system will need a regulator to drop the high pressure of the tank—roughly 850 psi at room temperature—down to the lower pressures you'll use for carbonation—30 to 45 psi. This regulator enables you to effortlessly change the pressure with which you are carbonating. Prices vary widely. If you are using the system at home, go for inexpensive regulators like the 0–60 psi regulators from Taprite, which will set you back only about $50. At the bar, where our regulators get regular abuse, I use heavy-duty models with protective cages over their pressure gauges (the most fragile part of the regulator). CO_2 regulators have two gauges, one to show the pressure of the tank and one to show the pressure coming out of the regulator. You cannot use the tank pressure to figure out how much CO_2 you have left. The majority of the CO_2 in your tank is a liquid. As you take gas out of the tank, some of the liquid CO_2 turns to gas and maintains a constant pressure inside the tank, so the gauge will still read full pressure until the tank is almost empty. The weight of the tank and the sound of liquid sloshing about inside it are the only reliable measures of CO_2.

BALL-LOCK CONNECTOR: A length of reinforced hose will connect your regulator to a special fitting called a ball-lock gas connector. Ball-lock connectors are special doodads that were designed in the 1950s to pressurize and dispense from 5-gallon soda kegs (one of two such systems; the other is known as pin-lock). Soda suppliers would ship the soda, known as premix soda, to bars and restaurants in those kegs. The competing system, also designed in the 1950s, is called bag-in-box. With a bag-in-box system, syrup is added to carbonated water at the last minute, just before the drink enters the glass. The two systems existed side-by-side for a while, but bag-in-box eventually won out and rendered soda kegs and their connectors obsolete. In the 1990s and early years of this century, while bag-in-box was consolidating its hegemony over the fountain soda world, the market was flooded with surplus premix soda kegs and connectors. Home brewers snatched them up. Buying surplus, home brewers (yep, I was one) could brew, keg, and tap their beers in convenient 5-gallon quantities, almost for free. Those were good times. Today the surplus is gone, but the home brewer’s love is not, and the ball-lock soda fittings and kegs live on, at a higher but still reasonable price.

Some crazy home brewers loved ball-lock fittings so much that they made a cap—the carbonator cap—to attach their beloved ball-lock fittings directly to standard soda bottles. They weren’t trying to make a great cocktail system; they just wanted an easy way to keep their beer carbonated in small quantities. I started using them as soon as I found out about them, and they were quickly embraced by tech-minded cocktail folk. They cost around $15 apiece and last for many, many hundreds of carbonation cycles, as do the soda bottles you’ll use with them.

This entire carbonation rig—tank with gas, regulator, hoses, fittings, caps, and bottles—should cost you less than $200. Here is how to use it.

CARBONATING WITH BOTTLE, CAP, AND TANK: Turn on the CO_2 gas cylinder and adjust your pressure (for most cocktails I use 42 psi.) Fill a soda bottle two-thirds to three-quarters full with very, very cold beverage. At the bar I have a special freezer, the Randall FX, to chill my drinks to exactly the temperature I want—typically 7°C (20°F). At home you can just leave your drinks in the freezer till they get syrupy (high alcohol) or just start forming ice crystals (lower alcohol). The ice crystals will melt as you carbonate. You can also chill drinks with dry ice or liquid nitrogen, but make sure neither gets into the bottle: explosion hazard!

Now squeeze all the extra air out of the bottle—remember that air is your enemy—and screw on the carbonator cap. Use your fingers to pull up on the ring around the ball-lock connector, press it down hard on the carbonator cap, and release the ring. Many people have problems managing the connector the first few times. You will get the hang of it pretty quickly. As soon as the connector is on, the bottle will inflate quickly, which is fun to watch.

Now, with the gas connected, shake the drink like your life depends on it. You will hear and feel the gas leaving the tank and going into your drink. Sounds like the creaking hull of a ship. Don't hold the bottle upside-down when you shake lest cocktail get into your gas line, which is icky. After you shake the drink, pop off the connector and crack open the carbonator cap to let the drink foam up. Don't unscrew the cap all the way, or you and everyone around you will be covered in cocktail. After the foam has died down, carbonate again and foam again. Carbonate a third time and you should be done.

Let the bottle rest for at least 30 seconds—longer is better, up to a minute or two—before you open to pour. A little residual foam on the surface of the drink is acceptable. The problem is bubbles in the drink itself. You want to wait for all those bubbles to rise to the top and pop. You'll know when you are ready to open because the drink will appear clear. When you open to pour, crack the cap very gently. At this point you want to prevent foam. After you pour your drink, squeeze a little excess gas out of the bottle (in case some air got in), screw on the carbonator cap, and hit the bottle with CO_2 again—a process I call fluffing. If you keep the temperature right and fluff every time you pour, the last cocktail you pour out of the bottle will be as good as the first.

I find that my results are best when my bottles are filled two-thirds to three-quarters full. Any fuller and it is hard to defoam the drink. Any less full and it is hard to get the air out. I also feel in my heart that the carbonation I get in an underfilled bottle isn't as good, but my head doesn't know why. To make sure I'm always using optimum fill levels, I stock a variety of soda bottles: 2 liters, 1.5 liters, 1 liter, 20 ounces (591.5 ml), 16.9 ounces (500 ml—Poland Spring makes these), and 12 ounces (354.9 ml—hard to find, but Coke makes some). I use the 2 liters for large events where I'm pouring a lot in a short time, although the sloshing you get when you pour out of a 2-liter bottle makes me wince. I use the 1-liter bottles at the bar. The small 16.9-and 12-ounce bottles are superhandy to keep around for recipe testing. They can carbonate a single drink.

Carbonating a vermouth cocktail with a carbonator cap. ***1)*** *Squeeze all the air out of your bottle.* ***2)*** *Screw on the carbonator cap.* ***3)*** *Pull up on the ring of ball-lock connector, push it down on the carbonator cap and release the ring to apply gas. Sometimes it takes people a while to get the hang of this.* ***4)*** *When the pressure of the gas is applied, the bottle inflates rapidly.* ***5)*** *Shake.* ***6)*** *Vent and allow foaming.* ***7)*** *Pressurize and shake again.* ***8)*** *Vent and allow foaming.* ***9)*** *Pressurize and shake again.* ***10)*** *Wait until all bubbles subside and then gently open the bottle.* ***11)*** *Pour at an angle.* ***12)*** *The drink.*

There are two downsides to this system: the recycled plastic bottles don't look sexy behind the bar, and the carbonation cycle takes a bit too long to make individual drinks to order. Regardless, it's the best system out there.

TECHNIQUE TWO: SODASTREAM

The Sodastream carbonator has revolutionized home carbonation. The manufacturer warns you not to carbonate anything other than pure water, but you can, provided you are careful. With water, Sodastreams are supersimple to use: just fill the special bottle up to the fill line with cold water, screw it into the machine, and press the carbonator button till the machine breaks wind. The Sodastream doesn't require any shaking and doesn't require you to purge the headspace of the bottle. Instead, it submerges a carbonator wand just below the surface of the water. When you push the button, the wand injects CO_2 into the water, creating zillions of tiny bubbles with their attendant surface area and obviating the need for shaking. At the same time, CO_2 rushes out of the drink and pushes up into the headspace. When the pressure in the bottle exceeds the factory-set carbonation pressure, a relief valve opens up and lets the CO_2 push the air out of the headspace with a rather impolite sound. Smart system. You can't adjust the pressure in a

Sodastream, but it can produce adequate carbonation in most cocktails.

The problem with carbonating cocktails is the pesky foam. If you carbonate something that foams, you can clog the relief valve. If you clog the relief valve, the pressure that builds up can cause damage to the Sodastream itself and, if the bottle ruptures or flies out of the machine, to anything nearby.

The trick to carbonating wine or cocktails in the Sodastream: make sure you never let the foam get all the way to the top of the bottle. You will not be able to fill up the bottle to the fill line. In fact, don't fill the bottle more than one-third of the way to the fill line—about 11 ounces (330 ml), which equals two drinks. You need to leave plenty of room for the drink to foam. At one-third full the carbonator wand will not be submerged. That's okay. The force from the spraying CO_2 is strong enough to create tiny carbonating bubbles even if the wand isn't submerged. You'll just need to press the button a few more times and waste more CO_2 than you would when carbonating water. You can't make less than two drinks, however, because if your fill level is too low, the CO_2 won't get injected well.

Therefore, in one sentence, the secret of the Sodastream is **always carbonate exactly two 5½-ounce (165-ml) drinks**.

PLASTIC SODA BOTTLES

Plastic soda bottles are made from polyethylene terephthalate, aka PET (or PETE), the most common form of polyester. It's the same stuff from which fine leisure suits are crafted. PET soda bottles are cheap and flexible and can easily handle the pressures involved in carbonation. PET bottles for still beverages can't handle the pressure; I've had them blow up. There isn't any real danger when one of those bottles blows while you're carbonating, but it sure is embarrassing: imagine a small chef's office with a 360-degree line of carbonated iced coffee sprayed across the wall at chest level. Even the carbonation bottles aren't indestructible, however. Don't stick chunks of dry ice in them; they will blow up. Ditto with liquid nitrogen. Don't put boiling hot liquids in them either, or they'll deform. Over long periods of time, PET bottles can pick up aromas and colors from the sodas they hold, so stay away from root-beer bottles and orange-soda bottles.

Carbonator caps are supposed to fit on any standard soda bottle up to 2 liters. Unfortunately, the soda industry introduced a new cap style several years ago. The new caps are shorter. Shorter caps are good because they save plastic, but bad because carbonator caps don't fit their bottles as well. You *can* use the carbonator caps with new-style bottles, but get the old style if you can.

Unlike glass, which is a perfect gas barrier, PET soda bottles slowly leak gas. The majority of the leakage is straight through the walls of the bottle; they are semipermeable to gases. This is the reason you shouldn't stock up on soda in plastic bottles and leave them in your pantry for months. The lifetime of a PET bottle of soda is measured in weeks before it starts tasting flat. The smaller the bottle, the more surface area the bottle has per unit volume, so the faster it goes flat. This is why bars always buy tiny glass bottles of soda—plastic bottles that size would go flat really fast. If you want to store a home-carbonated product for a long time, make sure to fluff the bottle with CO_2 every week or so to maintain carbonation.

A newer version of soda bottle is made of layers of PET and polyvinyl alcohol (PVA). PVA is a much better gas barrier than PET and degrades into harmless products when the bottles are recycled, so these bottles are still recyclable and they maintain carbonation much better than plain PET bottles. Unfortunately, the bottles are just labeled with the PET recycling code, so you can't know whether you have one.

From an environmental and health perspective, it might interest you to know that in 2011, only 29 percent of all PET bottles were actually recycled (according to EPA data). Frown. But according to the National Association for PET Container Resources (NAPCOR), the rate of recycling is increasing. NAPCOR also vehemently asserts that it is safe to reuse, freeze, and store products in PET, that nothing is ever leached into your beverage from PET, that PET contains no evil bisphenol A, and that even though the word *phthalate* is in the name of the plastic, the phthalates in PET aren't the ones we should be worried about. Of course, whether you choose to believe data provided by a trade group whose sole mission is to support the use of PET containers is up to you. From my perspective, I have drunk out of PET my whole life. I currently use PET, and serve drinks made in it to my family. That doesn't mean I can state with apodictic certainty that there is nothing wrong with PET, but I will continue to use it till I hear credible rumblings of safety concerns.

CARBONATING A GIN AND JUICE IN A SODASTREAM: 1) *Make sure your liquid is cold—this one is almost crystallizing.* ***2)*** *Charge with gas until the pressure release vents.* ***3)*** *Carefully vent. Be careful—you must be able to instantly re-tighten and seal the bottle. Do not let foam hit the top of the bottle.* ***4)*** *Charge with gas again until the pressure release vents.* ***5)*** *Carefully vent.* ***6)*** *Charge with gas again until the pressure release vents.* ***7)*** *Wait for bubbles to subside.* ***8)*** *Notice there is no foaming when I unscrew the bottle this last time.* ***9)*** *The drink.*

Just as with other all carbonation techniques, you should vent the

Sodastream to atmospheric pressure and recarbonate several times. Again, you must be careful when releasing pressure. Your cocktail will foam. Make sure you can stop the releasing procedure quickly. Practice releasing the pressure and sealing it again several times while carbonating pure water to get the hang of it. The foam can shoot into the relief valve with surprising rapidity. Do not let the foam get up and into the relief valve. Never put any pulp into this system—you will create messy, messy problems. Let the drink settle down a bit after your last carbonation cycle before you do your final venting. Make sure your product is supercold, almost frozen cold, to keep foaming down and increase bubble quality.

Sodastream has released many different models. These instructions should work with most of them. Don't get the glass one for carbonating cocktails—it operates a bit differently and has to be hacked. It also makes me nervous.

The advantages of the Sodastream system are its small footprint, ease of use, and ubiquity. But you'll spend a lot more money on CO_2 than you will with a proper tank. Carbonating wine and cocktails burns through CO_2 much faster than carbonating water.

Never allow a Sodastream to foam into the area above the top of the bottle—you could clog the safety valve. When unscrewing the bottle only unscrew a tiny bit at a time.

WATER FOR CARBONATION

Good seltzer starts with good water. If your water doesn't taste good, your seltzer will taste even worse. If your municipality has bad water, filter it or use jugs of spring water. My favorite seltzer base? New York City tap water, which is soft and has no off flavors for the bubbles to magnify. Many people like water with a lot of dissolved minerals. The minerals add taste and mediate the way your tongue perceives CO_2, usually by making things taste less carbonated than they really are. While I enjoy mineralized waters such as Apollinaris, Gerolsteiner, and Vichy on occasion, for maximum refreshment give me seltzer made from soft water any day.

Even if your water tastes fine, make sure that it contains no chlorine. Chlorine tastes poisonous in seltzer. If your water contains chlorine and your pipes are lead-free, you can use heat to drive off the chlorine. Start with hot water that you allow to cool, or heat cold water on the stove and then cool it down.

TECHNIQUE THREE: ISI WHIPPER

Using whipped-cream makers and cartridges of CO_2 to carbonate is my least-favorite common technique, and I resort to it only when there is no alternative. Whipped-cream makers are not the same as seltzer-water makers, which also use cartridges. Strangely, the whipped-cream maker makes better bubbles than the seltzer version, which I never, ever use.

Cream whippers use 7.5-gram cartridges of gas: CO_2 for soda, N_2O for whipped cream. Compared to any other form of buying CO_2, these cartridges are superexpensive—up to a dollar apiece. You’ll need at least two of them every time you carbonate. Even worse, you cannot control the pressure inside; your only choice is whether or not to add another 8-gram cartridge.

If you must carbonate using a cream whipper, keep it in the freezer for a while before you carbonate, because the vessel has enough steel in it to significantly warm your drink. I also recommend throwing an ice cube or two into the whipper along with your chilled beverage. Scale your recipe to make enough mix to fill your whipper approximately one-third full. Don’t fill the whipper more than halfway. Try to keep your fill levels the same all the time: the pressure in the bottle—and therefore the level of carbonation you get—is dependent on the fill line. Before you screw the top on, make sure the valve is clean—it easily gets filled with schmutz if you use the whipper for infusions—and that its main gasket is in place. If either of those two things is messed up, the whipper won’t pressurize and you will have wasted a cartridge.

Now put in your first CO_2 cartridge and shake the whipper violently. After you shake it, hold it upright and use the dispensing handle to vent out the headspace air and to blast the air off potential nucleation sites in the cocktail. If cocktail starts spraying out the top, release the handle and wait a second before resuming your vent. After the cocktail is vented, add another CO_2 cartridge and shake again. Let the whipper sit undisturbed for a while so the drink settles before you slowly vent the gas. To serve, unscrew the top and pour.

CARBONATING A RED CABBAGE JUSTINO COCKTAIL WITH AN ISI: 1) *Chill your drink and add it to the pre-chilled iSi whipper.* ***2)*** *Add a couple extra ice cubes.* ***3)*** *Charge with* CO_2*.* ***4)*** *Shake.* ***5)*** *Vent.* ***6)***

Charge with CO_2 again. ***7)*** *Shake. Wait a minute for the bubbles to subside, and* ***8)*** *slowly vent.* ***9)*** *The drink.*

PUTTING BUBBLES ON DRAFT

At home I have seltzer water on draft. Given the quantities I consume, any other system is cost-prohibitive for me. I use a 5.3-liter Big Mac McCann commercial carbonator plumbed to my water supply. The Big Mac is the type of unit a restaurant uses to make draft sodas at a bar. It works quite well. The reason most bars have crappy soda isn't a result of their carbonators; it's a result of poor filtration, poor chilling, and poor dispensing—the same factors you need to control for good seltzer.

Filtration first: before the water gets to the carbonator I run it through a dedicated filter to remove chlorine and sediment. In your area you might need a more sophisticated filtration or water-treatment system to make good seltzer. Just remember, if it tastes bad flat, it will taste worse with bubbles.

Next, chilling: I use a cold plate, as bars do for soda, but a little differently. A cold plate is a block of aluminum filled with stainless steel tubing, kept in ice to chill drinks on the fly. You see, carbonators carbonate water at room temperature at very high pressure, like 100 psi. As the water passes through the cold plate it is chilled and the liquid is slowed down, causing a pressure drop that prevents the soda from spraying everywhere when you dispense it. Cold-plate circuits aren't long enough to chill the seltzer or to slow it down adequately, so I run the seltzer through two circuits in a series. Works perfectly, and everyone I've shown this technique to swears by it. Make sure to buy a cold plate with more than one circuit in it.

Last, dispensing: most people ruin their soda with poor dispensing equipment. A CMBecker premix soda tap is the only tap you should ever use to dispense highly carbonated beverages (they are scarce; see Sources, here). Never attempt to use beer taps, aka picnic taps, for this purpose unless you hate quality. The Becker premix valves have a special pressure-compensation system that gently eases carbonated beverages from the world of high pressure to our world of low pressure with a minimum of bubble loss. They also have a tunable flow rate. At home I have a Becker valve that has been in continuous service, pumping out seltzer for over fourteen years with nary a problem. My seltzer is good.

As your mania for bubbles grows, you might decide to make some draft sodas or even draft cocktails. From a quality standpoint, these are fraught with peril. You have all the problems of seltzer, magnified. If you really want to draft cocktails, I can only recommend drinks that want minimal carbonation and can be served on the warmer side (like at 36°F/2°C).

MY DRAFT SELTZER RIG: *Regular tap water is filtered and runs to my McCann carbonator (blue lines). A pump on the carbonator forces the water under pressure into the stainless-steel carbonator tank.* CO_2 *is fed into the stainless tank at 100–110 psi to supply gas and pressure (yellow lines). Room-temperature seltzer exits the tank and heads for a cold plate in my ice machine (green lines). The seltzer runs through the cold plate two times (one of my secrets) then exits and heads above the cabinet to my seltzer tap.*

The only carbonation advantage of the whipper: it lets you experiment with nitrous oxide, the standard gas for making whipped cream. Whipped cream is always made with nitrous so that the cream doesn't taste carbonated and spoiled. Nitrous doesn't add much flavor to whipped cream because it is expanded out, but what flavor it does have is sweet. Used as a bubble source in drinks, it is noticeably sweet. For this reason, it works well in coffee-and chocolate-flavored drinks. It adds body and liveliness with no carbonation taste. Avoid milk in these drinks, as it foams way too much.

If you want to try mixed gas, carbonate normally using two CO_2 cartridges and then add a nitrous cartridge to finish. Done in supercold ice water, a two-CO_2 one-N_2O carbonation job approximates my favorite bubbly water, which I make with my souped-up mixed-gas system (80 percent CO_2, 20 percent N_2O at 45 psi in ice water).

My seltzer tap, a pre-mix soda valve made by CMBecker, fitted to an Ibis tower.

CARBONATION IN A NUTSHELL

Everything that came before, distilled to a few sentences for easy reference.

Always remember the three C’s of carbonation:

- **Clarity**—the drinks you carbonate should be clear.
- **Coldness**—the drinks should be cold, usually as close to freezing as possible.
- **Composition**—get rid of bubble nucleation sites. Try to avoid ingredients that foam too much, try keep your alcohol levels on the low side most of the time, and remove as much air as possible from your drink.

When you carbonate, remember these tips:

- **Carbonate each drink several times** and allow it to foam between each carbonation cycle. This is one of the key tricks to getting rid of nucleation sites and getting long-lasting bubbles.
- **Don’t overfill your carbonation vessels**, or you will find it impossible to control foam and to carbonate properly. Proper headspace will depend on your application, but bottles that must be shaken should never be filled more than three-quarters full, and Sodastream bottles should never be

filled to more than one-third of their normal capacity when carbonating foamy drinks (like cocktails).

- **Don't underfill your carbonation vessels.** For each system there is an optimum recipe size. When you go too low, you risk inconsistent results.
- **Don't use too much pressure**. If your drink is foaming excessively and tastes flat in the glass, your carbonation pressure is too high—you are trying to add more CO_2 than your drink can hold without gushing. Try lowering the pressure. If that doesn't work, go back and address the three C's—clarity, coldness, and composition. See the recipe section below for specific pressure recommendations.
- **Up the surface area**. Carbonation requires agitation to get CO_2 into your drink, typically by shaking under pressure or by injecting bubbles. Any effective carbonation scheme has a mechanism for increasing surface area and agitation. Pressure alone won't work.

Three important things to remember about carbonation theory:

- **Pressure**—as the pressure goes up, so does the amount of CO_2 you put into a drink.
- **Temperature**—as the temperature goes down, you increase the amount of CO_2 a liquid can hold.
- **Alcohol**—the higher the alcohol content of your drink, the more CO_2 you need to add for the same feeling of carbonation in your mouth.

RECIPES: WHAT TO CARBONATE

In the following recipes I give you the usual bartender-style measurements—a fat ¾ ounce of lime juice and such—and also the much more precise milliliter measures. The standard bartender measures will work fine from drink to drink, and they convey the meaning of recipes to within the accuracy of most folks' jiggering skills. When you are batching multiple drinks at a time, you will be much better served doing as I do: using milliliter measurements and a graduated cylinder.

NONALCOHOLIC DRINKS

Recipes for carbonated sodas are fairly straightforward. The main ingredient of soda is usually water, so use water that tastes good. Make sure it doesn't smell of chlorine.

Most sodas contain between 9 and 12 grams of sugar per 100 milliliters of beverage, which is pretty sweet for something you might pound in large quantities. Unfortunately, in my experience, reducing the sugar quantities much lower than 8 grams per 100 milliliters doesn't make a soda seem drier, it just makes it seem underflavored and watery. I suspect the reason for this is the lack of alcohol. Alcoholic drinks have a built-in flavor structure that exists without sugar, so sweetening an alcoholic drink doesn't require as much sugar. Water tastes like . . . water. It is possible to make highly flavored nonalcoholic drinks that are low in sugar, be they bitter or sour, but people don't perceive these as legitimate sodas; they perceive them as flavored seltzers—not the same thing. People expect sodas to be relatively sweet and, most of the time, tart as well.

When making sodas, you have two chilling options: mix your ingredients and put them in the fridge for several hours, or use ice. Ice is faster, and because it gets all the way down to 0°C (32°F), it makes sodas colder and easier to carbonate. To use ice for soda you need a container marked for the full volume of your finished drink. Get some ice water—not cold water, but water with pieces of ice in it. Add all of your nonwater ingredients to the marked container. Take some ice from the ice water, add it to your ingredients, and stir till the ingredients are chilled to 0°C (32°F). If you still have a bunch of ice left in the container, pull some out and just leave a chip or two. If all the ice melts, add a bit more.

When you are satisfied that your flavor base is chilled, give your ice water a stir (to get the whole shebang down to freezing again) and fill your mixing container with water to the fill line. Leave a small piece or two of ice in the mix—it will melt as you carbonate and help keep your drink cold during the process. Don't worry about the extra nucleation sites the ice produces. One or two pieces won't cause the same problems as scads of tiny ice crystals.

Simple Lime Soda

For this recipe you may use either clarified lime juice or lime acid. Lime acid is a mixture of malic and citric acids that imitates regular lime juice (4 grams citric acid and 2 grams malic acid in 94 grams water). Use this recipe as the basis of all your sour-type soda recipes. The ounce of simple syrup this recipe contains supplies 18.5 grams of sugar, making the whole 6-ounce (180 ml) recipe a hair supplies 18.5 grams of sugar, making the whole 6-ounce (180-ml) recipe a hair over 10 percent sugar (w/v).

MAKES 6 OUNCES (180 ML) AT 10.5 G/100 ML SUGAR, 0.75% ACID

INGREDIENTS

1 ounce (30 ml) simple syrup

¾ ounce (22.5 ml) clarified lime juice or lime acid base

4¼ ounces (127.5 ml) filtered water

2 drops saline solution or a pinch of salt

PROCEDURE

Combine all the ingredients and chill in the refrigerator for several hours before carbonating at 35–40 psi, or follow the ice-water procedure above.

Strawbunkle Soda

I made this recipe a couple of years ago when my son Dax was reading *The Big Friendly Giant*, by Roald Dahl. The BFG mispronounces many things, including *strawberries*. Dax pointed out that I share this intentional mispronunciation trait—hence the soda name. Clarified strawberry juice is about 8% sugar and 1.5% acid, a bit too acidic to make directly into a soda. Even if the acid level was right, straight strawberry soda would also be too dang juicy and overpowering. I add simple syrup to balance the acid, and water to mellow the flavor.

MAKES 6 OUNCES (180 ML) AT 10.1 G/100 ML SUGAR, 0.94% ACID

INGREDIENTS

½ ounce (15 ml) simple syrup (this contains 9.2 grams of sugar)

3¾ ounces (112.5 ml) clarified strawberry juice

1¾ ounces (52.5 ml) filtered water

2 drops saline solution or a pinch of salt

2 drops saline solution or a pinch of salt

PROCEDURE

Combine all the ingredients and chill in the refrigerator for several hours before carbonating at 35–40 psi, or follow the ice-water procedure above.

WINES AND SAKE

Traditional carbonated wines, like champagne, aren’t force-carbonated. They are naturally carbonated by yeast’s action on the sugar that is added after the wine’s primary fermentation and before the bottles are sealed. The flavor and body resulting from this extended second fermentation are completely different from the results you get with force carbonation. Not better, just different. When you choose a wine to carbonate, ask yourself if the wine will be good cold—not slightly chilled like a nice glass of Beaujolais in the summer, but cold. Put a bottle in the fridge and leave it there. Taste it. If a cold wine is out of balance or overly tannic when flat, carbonation won’t help it.

Unlike cocktails, sparkling wines don’t taste best when chilled below refrigerator temperature. I overchill the wines I plan to carbonate by submerging the bottles in ice water, since the cold facilitates carbonation and guarantees consistency. But I let them come up a couple of degrees before serving.

The pressures you'll use to carbonate depend on the alcohol content of the wine. At 0°C (32°F) a low-alcohol white—in the range of 10 to 12 percent—should be carbonated with 30 to 35 psi of CO_2. Any more and you'll lose the fruit. Wines in the 14–15 percent alcohol range should be carbonated to 40 psi at 0°C. Sake, which could be up to 18 percent alcohol, should be carbonated to 42–45 psi at 0°C.

When I first began carbonating wines, I thought all my experiments were delicious. I was a carbonation genius! But then I conducted a rigorous series of tastings, sampling the original still wine against my carbonated version. You know what? Most of the time, even if the carbonated wine was good, the still version was better. Only occasionally was the carbonated version a revelation compared to the original.

The moral? Don't become enamored of your capabilities. As doctors of our ingredients, our first mission is to do them no harm—the Hippocratic Oath of cooking.

FLUFFING EXISTING CARBONATED COCKTAILS

If you have no patience for making your own mixers but you do have the ability to carbonate, it is simple to up your bubbly cocktail game by simply making a basic drink—whiskey soda or vodka tonic, for instance—and then force-carbonating the whole kit and caboodle. If you keep your straight booze in the freezer (usually –20°C/–4°F) and your mixer in the fridge, you can mix a typical cocktail and carbonate right away with very little fuss. I recommend a ratio of 2 ounces (60 ml) of freezer booze to 3.5 ounces (105 ml) refrigerated mixer.

Fluffing a gin and tonic in a Sodastream.

MIXING YOUR OWN

I shoot for between 14 and 16 percent alcohol in my carbonated drinks. I push some drinks with stronger flavors to 17 or 18 percent alcohol. To get the correct alcohol range, use my magic ratio: every 5½-ounce (165-ml) carbonated drink contains between 1¾ and 2 ounces (52.5 and 60 ml) of booze between 40 and 50 percent alcohol. I find that this ratio almost always works. It is almost always right. Tasted flat, these drinks are absurdly weak. They taste watery. Believe me, when you carbonate them, you'll like them better than stronger versions.

In fact, all the flavors in a carbonated beverage should taste a bit weak when the drink is flat. Most acidic shaken drinks will have about 0.8 to 0.9 percent acidity—the equivalent of ¾ ounce (22.5 ml) of lime juice in a 5¼-ounce (160-ml) finished drink. Most acidic carbonated drinks are between 0.4 and 0.5 percent acidity—the equivalent of a short ½ ounce (12 ml) of clarified lime juice in a 5½-ounce (165-ml) finished drink. Shaken drinks will usually be between 6.5 and 9.25 percent sugar. Carbonated drinks are mostly between 5 and 7.7 percent sugar. Notice that the acid is typically scaled back more than the sugar is. Also notice that these sugar levels are well below those found in most sodas. I'm not sure why we like our cocktails less sweet than our sodas, but we do.

Learn to taste flat drinks and know how they will taste carbonated. As a further experiment, make a stronger carbonated drink, then add a splash of seltzer and see if it doesn't taste better.

In the following recipes, all the ingredients are clarified. Some recipes, like Gin and Juice, can't be made without clarification. Others, like Gin and Tonic, will let you add some basic lime juice at the end. For the purposes of the recipes, however, I assume you'll be clarifying.

At the bar we batch and carbonate all our drinks prior to service. If we didn't prebatch, we'd never get the drinks out on time. Because we premake our carbonated drinks, freshness becomes an issue. We never add clarified lime or lemon juice to our drinks before we carbonate them. We make fresh clarified lemon and lime juice daily. Day-old is garbage. If we added lemon or lime before we carbonated, we'd have to throw away whatever was left in the bottles at the end of the night, which would make me sad, or serve a day-two drink that I wasn't proud of, which would make me supersad. Instead we add a small amount of clarified lemon or lime juice to the glass right before we pour the drink and serve it to our guest. The ¼ to ½ ounce (7.5 to 15 ml) of noncarbonated stuff we add to the drink doesn't hurt the bubbles. If you are carbonating and serving right away, don't worry about adding highly perishable ingredients like lime juice. If you want your drink to last a couple of days, add the fragile stuff later.

I serve carbonated drinks in champagne flutes chilled with liquid nitrogen. Serve this way and you'll never go back. Looks great, tastes great. Take the time to pour your drink gently down the side of the flute. You've worked so hard to make the drink—don't ruin it at the last minute with a careless pour.

WHICH BOOZE TO CHOOSE?

For my palate, gin is the easiest spirit to carbonate. Gin drinks just taste good carbonated. Vodka can be carbonated to good effect when you have fruits or spices that you want to highlight without an assertive spirit competing for attention. Tequila can be difficult. Strongly flavored tequilas tend to get even stronger when they are carbonated, and they can overpower. Very light tequilas carbonate just fine. Strong tequilas can be cut with vodka to mellow their tone a bit. White rums can be carbonated, but I like carbonated rum drinks much less than I thought I would, considering how much I love rum; somehow, most carbonated rum drinks taste cheap and fake to me. I've had—and made—decent carbonated rum drinks, but I find them very challenging.

Oaked spirits intensify their oakiness when they are carbonated. If you like a whiskey soda, you'll probably like carbonated whiskey drinks too. I find they are difficult to balance properly. Many liqueurs are champions in carbonated cocktails. Campari and its cousin Aperol scream to be carbonated. Just remember when using liqueurs not to make the batch too sweet, or the drink will be cloying.

SOME UNITS TO REMEMBER WHEN YOU MAKE AND ADJUST RECIPES

- One standard carbonated drink is 5½ ounces (165 ml). Scale the recipes as you wish.
- Every ½ ounce (15 ml) of 1:1 simple syrup will add 9.2 grams of sugar and will increase the sugar in a standard size (5.5-oz, 165-ml) carbonated drink by 5.6 percent.
- Every ½ ounce (15 ml) of clarified lime juice will add 0.9 grams of acid (0.6 grams citric and 0.3 grams malic) and will increase the acidity in a standard size (5.5-oz, 165-ml) carbonated drink by 0.55 percent.

X, Y, OR Z AND SODA

Anytime you have to make an "-and-soda" drink, your choices are fairly simple: decide on the ratio of booze to water. With stronger-flavored liquors, like whiskey, I like to use a short 2 ounces (57 ml) of spirit to a fat 3½ ounces (108 ml) of water. Use good, filtered water and don't pour the drink over the rocks—it doesn't need any more water. For fairly neutral spirits like vodka, I up the alcohol percentage slightly, maybe up to a full 2 ounces. I don't go over that percentage unless someone specifically requests it. My only secret with these -and-soda drinks: add a drop or two of saline solution (or a couple grains of salt).

CARBONATING A CLASSIC

The first trick to carbonating a classic is to choose the right cocktail. Some, like the Manhattan, are an abomination when carbonated. I carbonate Manhattans as object lessons in what can go wrong when you carbonate. They are wretched and unbalanced. Luckily, many classics, like the margarita and the Negroni, carbonate quite well. Here's how to modify those two recipes to make them work with bubbles. See how I modified them and then modify your own.

Carbonated Margarita

Classic margaritas are a mix of agave-based spirits, orange liqueur, lime juice, and sugar. In this recipe I omit the orange liqueur; I think it muddies the taste. Instead I twist an orange rind over the surface of the drink before I serve it. The ratios in this recipe work for many sour drinks, so use it as a master recipe.

MAKES ONE $5\frac{1}{2}$ OUNCES (165 ML) DRINK AT 14.2% ALCOHOL BY VOLUME, 7.1 G/100 ML SUGAR, 0.44% ACID

INGREDIENTS

Short 2 ounces (58.5 ml) light-bodied, clean tequila like Espolón Blanco (40% alcohol by volume)

Fat $2\frac{1}{2}$ ounces (76 ml) filtered water

Short $\frac{1}{2}$ ounce (12 ml) clarified lime juice

Short $\frac{3}{4}$ ounce (18.75 ml) simple syrup

2–5 drops saline solution or a generous pinch of salt

1 orange twist

PROCEDURE

Combine the first five ingredients and chill till almost frozen. Carbonate at 42 psi. Pour into a chilled flute. Express the orange twist over the top of the drink and discard. If you want the drink to keep for several days, carbonate without the lime juice and add the lime juice before serving.

Carbonated Negroni

The classic Negroni is

1 ounce (30 ml) gin (47% alcohol by volume)

1 ounce (30 ml) Campari (24% alcohol by volume, 24% sugar)

1 ounce (30 ml) vermouth (16.5% alcohol by volume, 16% sugar, 0.6% acid)

The volume of the recipe as written is 3 ounces (90 ml). If you add 2½ ounces (75 ml) water to make the drink volume proper for a single carbonated drink, the result would have an alcohol by volume of 16% with 7.3% sugar. Both those numbers are pretty good. The acid level is a bit low at 0.18%, but the Negroni is not an acidic drink. If you need a refresher on how I got these numbers, check the cocktail math section of the book, here.

If you want to make it more refreshing, you can sub out ¼ ounce (7.5 ml) of the water with clarified lime juice or an acid of your choice. Finish it off with a twist of grapefruit-peel oil.

MAKES ONE 5½-OUNCE (165-ML) DRINK AT 16% ALCOHOL BY VOLUME, 7.3 G/100 ML SUGAR, 0.38% ACID

INGREDIENTS

1 ounce (30 ml) gin

1 ounce (30 ml) Campari

1 ounce (30 ml) sweet vermouth

¼ ounce (7.5 ml) clarified lime juice

2¼ ounces (67.5 ml) filtered water

1–2 drops saline solution or a pinch of salt

1 grapefruit twist

PROCEDURE

Combine everything but the twist and chill till almost frozen. Carbonate at 42 psi. Pour into a chilled flute. Twist the grapefruit peel over the drink and discard the peel. If you want the drink to keep for several days, carbonate without the lime juice and add the lime juice before serving.

Champari Spritz

Campari and soda is a classic low-alcohol summer favorite, good for times when the carbonated Negroni is a bit too much but you still want that Campari hit.

Once carbonated with a squeeze of lime, Campari is the epitome of bitter, bracing, and refreshing. Instead of adding a twist of lime, I add champagne acid; hence the name. Champagne acid is the same mix of acids that is naturally present in champagne diluted to lime-juice strength (30 grams tartaric acid and 30 grams lactic acid in 940 grams water); see the Acids section, here, for details. Champagne acid shifts the drink into a winy, champagney area that I really like. If you make this recipe more than a couple hours in advance, don't add the champagne acid until you are ready to serve. Although champagne acid doesn't spoil like lime juice, over time it makes the Campari taste progressively and unpleasantly bitter. I don't know why. This cocktail will last a week in the fridge. Notice I said fridge, not freezer. This drink is low in alcohol (7.2% alcohol by volume) and freezes easily.

MAKES ONE 5½-OUNCE (165-ML) DRINK AT 7.2% ALCOHOL BY VOLUME, 7.2 G/100 ML SUGAR, 0.44% ACID

INGREDIENTS

Fat 1½ ounces (48 ml) Campari (24% alcohol by volume, 24% sugar)

⅜ ounce (11 ml) champagne acid (6% acid)

3⅛ ounces (94 ml) filtered water

1–2 drops saline solution or a pinch of salt

PROCEDURE

Combine all the ingredients and chill in ice water to 0°C (32°F). Carbonate at 42 psi. Serve in a chilled flute.

Gin and Tonic

I explain the derivation of my gin and tonic recipe in depth elsewhere, but here is my recipe. This version is extremely dry and austere—the way I like it.

MAKES ONE 5½-OUNCES (165-ML) DRINK AT 15.4% ALCOHOL BY VOLUME, 4.9 G/100 ML SUGAR, 0.41% ACID

INGREDIENTS

Full 1¾ ounces (53.5 ml) Tanqueray gin (47% alcohol by volume)

Short ½ ounce (12.5 ml) Quinine Simple Syrup (61.5% sugar; see here)

Short 3 ounces (87 ml) filtered water

1–2 drops saline solution or a pinch of salt

$^3⁄_8$ ounce (11.25 ml) clarified lime juice (6% acid)

PROCEDURE

Combine all the ingredients (except the lime juice, if desired) and chill between –5° and –10° Celsius (14°–23°F). Carbonate at 42 psi. If you carbonate with the lime juice, serve the drink that day. If you carbonate without the juice, add it as the drink is poured into a chilled flute; your G&T will keep indefinitely.

Chartruth

This drink is for those of you who love Green Chartreuse as much as I do. If you aren't yet a fan, Green Chartreuse is an herbal smack in the face produced by Carthusian monks in France who've taken a vow of silence. This liquor is so badass that they named a color after it. This is the simplest expression possible: Chartreuse and water with a hint of lime. I call it the Chartruth. This drink is higher in both alcohol (18% alcohol by volume) and sugar (8.3%) than most good carbonated drinks. Because of the intensity of flavor, I like to pour a single drink into two small glasses and serve it to two people as a refreshing minidrink.

MAKES ONE 5$^1⁄_2$-OUNCE (165-ML) DRINK AT 18.0% ALCOHOL BY VOLUME, 8.3 G/100 ML SUGAR, 0.51% ACID

INGREDIENTS

Fat 1$^3⁄_4$ ounces (54 ml) Green Chartreuse (55% alcohol by volume, 25% sugar)

Short 3$^1⁄_4$ ounces (97 ml) filtered water

1–2 drops saline solution or a pinch of salt

Short $^1⁄_2$ ounce (14 ml) clarified lime juice (6% acid)

PROCEDURE

Combine all the ingredients except the clarified lime juice and chill to between –5° and –10°C (14°–23°F). Carbonate at 42 psi. Add the clarified lime juice as the drink is poured into a chilled flute. If you are going to serve the drink immediately, you may carbonate with the lime juice.

Adding the clarified lime juice to a Chartruth.

Gin and Juice

If I'm remembered for anything, I hope it is my Gin and Juice. Essentially just gin and clarified grapefruit juice, it is simple and satisfying.

Grapefruit juice is characteristically bitter, mainly owing to the compound naringin. The bitterness of the naringin in grapefruit is counteracted by sugar (10.4%) and high acidity (2.40%). To my taste, grapefruit juice balances perfectly in still drinks. In carbonated drinks, especially with gin, the bitterness becomes too much. Luckily, clarification removes some of grapefruit's bitterness. How much bitterness remains in the juice depends on the clarification technique you use. Most people making this recipe will clarify their juice using the seaweed gel agar (see the section on clarification, here). Agar strips a lot of bitterness from the juice and is a fantastic clarification technique for this drink.

At the bar I use a centrifuge to clarify grapefruit juice, because the yield on centrifugal clarification is so much higher than with agar—I waste almost no juice. Unfortunately, centrifugal clarification strips much less of grapefruit's bitterness. Simple syrup and a tiny amount of champagne acid are added to counteract the bitterness. I give you recipes for both agar-clarified and centrifuge-clarified Gin and Juice.

Grapefruit juice is too juicy-tasting to use without adding some water to the drink. How much water you add depends on how juicy you want your drink.

The recipes below balance with the grapefruits I get most of the time at the bar (California-grown Ruby Reds). Remember that grapefruits taste different depending on variety, orchard locale, and season, so you might have to tweak these recipes a bit depending on the fruit you have.

Last, I have used many different gins to make Gin and Juice, but nothing makes me as happy as Tanqueray. It just has an affinity for grapefruit juice.

The ingredients for Gin and Juice.

Pouring a Gin and Juice.

GIN AND JUICE: AGAR-CLARIFIED

MAKES ONE 5½-OUNCE (165-ML) DRINK AT 16.9% ALCOHOL BY VOLUME, 5 G/100 ML SUGAR 1.16% ACID

INGREDIENTS

Scant 2 ounces (59 ml) Tanqueray gin (47% alcohol by volume)

Short $2\frac{3}{4}$ ounces (80 ml) agar-clarified grapefruit juice

Fat $\frac{3}{4}$ ounce (26 ml) filtered water (If a slightly sweeter drink is desired, replace a bar spoon (4 ml) of the water with simple syrup; that will make the drink 6.3% sugar, 1.10% acid)

1–2 drops saline solution or a pinch of salt

GIN AND JUICE: CENTRIFUGALLY CLARIFIED

MAKES ONE $5\frac{1}{2}$-OUNCE (165-ML) DRINK AT 15.8% ALCOHOL BY VOLUME, 7.2 G/100 ML SUGAR, 0.91% ACID

INGREDIENTS

Fat $1\frac{3}{4}$ ounces (55 ml) Tanqueray gin (47% alcohol by volume)

Fat $1\frac{3}{4}$ ounces (55 ml) centrifuge-clarified grapefruit juice

Short $1\frac{1}{2}$ ounces (42 ml) filtered water

Fat $\frac{1}{4}$ ounce (10 ml) simple syrup

Scant bar spoon (3 ml) champagne acid (30 grams lactic acid and 30 grams tartaric acid in 940 grams water)

1–2 drops saline solution or a pinch of salt

PROCEDURE

Combine all the ingredients and chill between –5° and –10°C (14°–23°F). Carbonate at 42 psi. Serve in a chilled flute.

TECHNO-VARIANT

My other favorite clarified grapefruit juice recipe is Habanero-n-Juice. The recipe is the same, except instead of gin you use redistilled habanero vodka. Blend 200 grams of red habanero peppers with a liter of 40-proof vodka and distill it till you recover 650 ml of product in a rotary evaporator with a condenser temperature of –20°C and a bath temperature of 50°C. The habaneros must be red for the drink to work. Habaneros are one of the hottest peppers known, but also have fantastic flavor and aroma. Capsaicin, the compound responsible for the spiciness of the pepper, is too heavy to distill, so none of the heat is present in the distillate. Roto-habanero is one of my long-standing and favorite distillations. It goes amazingly well with grapefruit. If you make it, be aware that the distillate has a short shelf life. After a month or so, the "red" flavor of the distillate will fade and it will begin to taste "green," more like a jalapeño.

Habanero gin being vacuum distilled at low temperature to produce non-spicy habanero gin.

Flying the rotovap.

PART 4

Little JOURNEYS

In this last section I'll riff on three different subjects and see where they take me: apples, coffee, and the gin and tonic. I hope these journeys will give you insight into how I approach cocktail development. I usually start with a concept, a flavor, a fruit, an idea, or a memory. I develop a goal and try to get there. This approach to cocktails is the hardest thing to teach. So often, people think of cocktail development as the mere rearranging of spirits and juices.

I'll assume some familiarity with the techniques and concepts presented earlier in the book, so explanations here will be more laconic.

Apples

I love apples. I grew up in New York State, and apples are one of the things we do really, really well. Apples have not received their due as a cocktail ingredient. This is partly because apple juice isn't very concentrated, meaning that you must use a lot in a cocktail recipe to get the right flavor—and then it no longer works well in standard shaken, stirred, and built drinks. But I think the main reason is a lack of education.

Many of us grew up thinking there were two flavors of apple, red and green. Of course, we were wrong. There are thousands of apple varieties with startlingly different flavors, including notes of quince, orange, rose, anise, and wine. Some have preposterously high levels of acid and sugar. Some are delicate and aromatic. Some are austere. Each one of the thousands of varieties you can find today was named and propagated by someone, at some time, for some reason or another. Every apple was at one time loved by somebody. The trick is figuring out why—and then whether it is useful in a cocktail.

Some apples were loved for reasons that are irrelevant to us today. The Flower of Kent was saved for posterity because it was the apple that fell on Newton's head; it tastes bad. Some apples were loved because they performed well in a particular area. (Can you guess where Arkansas Black apples were first grown?) Other apples were loved because of their timing: early-season apples allowed cooks to make fresh apple pies in late June and early July, after their winter store of apples was exhausted. The need for early-season apples has been obviated by modern storing and shipping technology, so these apples now must stand on their own merits to survive. Sometimes they do, sometimes they don't.

My serious study of apple flavors began in 2007, when the eminent food writer and thinker Harold McGee and I visited the United States' apple collection in Geneva, New York. Yes, the United States maintains a collection of apple trees—thousands of them, two per variety, as in Noah's ark—just in case one of those trees holds some genetic material that will someday be useful to agribusiness. We tasted a couple hundred varieties over a two-day period, and what a treasure. Strangely, the keepers of the collection hadn't expected us to *taste* the apples. Apparently their usual visiting temperate-fruit pomologists just want to look at trees. When the keepers figured out our real purpose, they gave us a bemused look and allowed us free run. From the hundreds of apples we tasted, I was able to bring home and juice about twenty. The juices of those apples were the basis of my first serious apple cocktails, and one of them, Ashmead's Kernel, became my all-time favorite cocktail apple.

Since then I've been buying apples from local growers at my well-stocked New York City greenmarket and from other growers from all over the United States, as well as sampling many dozens of varieties as they grow in England. I have learned that my experience of an apple variety might not match yours. Apples are extremely dependent on where they are grown, when they are harvested, and the vagaries of the year's weather. Apples that grow well in mild climates might not ripen well in colder areas. Varieties meant for cold climates might taste insipid grown too warm. To make the best apple cocktails, you have to make the best juice. To make the best juice, you just have to taste a lot of apples, remember who grew them, and go back to those same purveyors year after year.

APPLE JUICE, THE COMMODITY

Commercial apple juice is a commodity product, and I advise that you leave it out of your cocktails. Oceans of apple juice are made every year from fruit that wasn't quite good enough to sell for eating. It's clarified, pasteurized, then often concentrated, shipped, reconstituted, blended with other reconstituted juice from who knows where, and sold. While this sort of product is fine for juice boxes, it's not good enough to partner with booze. Supermarket American sweet cider (sweet, as opposed to hard: the United States is the only country that refers to a nonalcoholic apple juice as cider) is more robust and versatile than regular juice, but I still can't recommend it for your cocktail work.

You can find some delicious single-variety and carefully blended apple juices and sweet ciders at specialty stores and farmers' markets, but they are typically marred by pasteurization. Everyone with whom I have blind-tasted has chosen unpasteurized apple juice and sweet cider over pasteurized. Some cold pasteurization methods use ultraviolet light that doesn't damage flavor nearly as much as heat, but you're unlikely to find products made this way in your market.

Last, almost without exception, store-bought apple juices and ciders are overoxidized and therefore brown. Fresh apple juice may be green, yellow, red, orange, or pink—it's never brown. The juice turns brown very quickly when exposed to oxygen, the same way a cut apple does. This oxidation destroys nuanced varietal flavors.

MAKING APPLE JUICE THE RIGHT WAY

For your cocktail work you'll need to make your own apple juice.

Wash your apples before you juice them, and look them over for signs of worms, rot, mold, and excessive bruising. The washing is important, because we will not be using heat. If the apple isn't clean enough to eat, it isn't clean enough to drink. Cut away any moldy or off-looking parts. A moldy apple can spoil a lot of juice and, even worse, can contain patulin, a possible carcinogen.

JUICING APPLES: *I use a Champion juicer and make sure the juice pours into a container that already contains ascorbic acid (vitamin C) so the juice never has a chance to oxidize* ***(LEFT)****. After I juice, I skim the majority of foam off the top, strain the juice through a fine strainer (the pulp is delicious) and, if I am going to clarify, add Pectinex ultra SP-L* ***(RIGHT)****.*

Never, ever peel an apple before you juice it. Most of the varietal-specific aromas, flavors, tannins, and apple pigments are concentrated in the flesh very close to the peel. Cut your apples up, but leave the skin on and throw them into a masticating juicer. These juicers, like my Champion, do a good job of extracting the flavor and color of the flesh near the skin. They have tiny teeth that pulp and shred the apple to bits and then smash those bits against a screen to get at the juice. Once upon a time I removed the cores and seeds prior to juicing, since the cores have little flavor and the seeds contain cyanide. Not anymore. I did a side-by-side taste test of apples juiced with and without cores and seeds, and I couldn’t tell the difference. The Champion doesn’t seem to extract any bitter flavor from the seeds; it leaves them mostly intact or simply broken in half, not pulped (hence you are not consuming them—no cyanide risk), and the lack of flavor in the core is insignificant since the core doesn’t yield much juice anyway.

A SPECTRUM OF APPLE JUICE COLORS (LEFT TO RIGHT): *Unnamed crabapple; Stayman Winesap; Honeycrisp; Suncrisp; Granny Smith. The crabapple juice is redder than the Stayman Winesap juice, even though the Winesap is a darker apple, because the crabapple is smaller, with a larger surface-area-to-volume ratio. There is more skin to leach color into the juice.*

THOSE SAME APPLE JUICES TREATED WITH PEXTINEX ULTRA SP-L: *The solids are floating on top because of trapped air. Gently rapping the glasses on the table and stirring would allow that stuff to settle to the bottom. Notice the juices contain different amounts of solids and clarify differently. Granny Smith on the right is almost completely clear, while the crabapple on the left hasn't settled at all.*

You will prevent oxidation by using vitamin C (ascorbic acid). Remember from the Ingredients section that vitamin C and citric acid are *not* the same (see here). Citric acid is the primary flavor acid in lemons. It does not directly prevent browning. Ascorbic acid doesn't change the tartness of lemons much, but is responsible for nearly all of their antibrowning power. Either toss the cut apples in ascorbic acid powder before you juice them, or put some ascorbic acid in the container you are juicing into. Make sure to stir the ascorbic acid into the juice after you juice your first apple or two. I use about 2.5 grams (1 teaspoon) of ascorbic acid per liter of juice, much more than is used commercially.

The crabapple juice from the previous photo after it has been spun in a centrifuge—a gorgeous pink. Some apple juices lose their richness when clarified. This crabapple, on the other hand, wasn't so great to eat and its juice wasn't much better, but once clarified it was spectacular.

You will now have real, fresh apple juice that tastes just like the apples it came from. If you have never tasted this kind of apple juice before, you will be angry that you have lived this long without it. The juice, however, is not cocktail-perfect: it is cloudy. You now must decide whether to clarify.

Apple juice flavor is greatly affected by clarification. Think of the difference between commercial apple juice and sweet cider. It isn’t just that the cider has more viscosity and body because of the suspended particles; those particles bring their own flavor, and that flavor is often good. So why clarify? If you plan to carbonate, you have no choice. If you plan to make a stirred drink, you *should* clarify—who wants a soupy-looking stirred drink? Choose an apple that retains its awesomeness once clarified. If you’re working toward a shaken drink, forget clarifying. Just strain the juice thoroughly to avoid unsightly pulp particles against the side of your glass and you’re good to go.

Before we get into some special cocktail-worthy apples, let’s look at some uses for supermarket varieties, both clarified and not.

Clarified: Granny Smith Soda

I’ll go nonalcoholic with this one. Granny Smiths, Australia’s most famous apple, are the go-to apple for cooks because they are tart, brisk, consistent, and easy to get. Their juice clarifies very well even without a centrifuge: just juice them, add some Pectinex Ultra SP-L, and let the juice sit overnight before you pour the clear stuff off the top (see the Clarification section, here; truth be told, if you let Granny juice sit long enough, you can get by without the enzymes). Grannies have a sugar-to-acid ratio that is perfect for soda (roughly 13 grams per 100 ml sugar and 0.93% acidity). Unfortunately, they just aren’t that interesting. But while monotonic flavor is a flaw in a cocktail, where the juice must stand up to and blend with liquor, it can work well in a soda.

MAKES 6 OUNCES (180 ML) AT 10.8 G/100 ML SUGAR, 0.77% ACID

INGREDIENTS

5 ounces (150 ml) clarified Granny Smith juice

1 ounce (30 ml) filtered water

2 drops saline solution or a pinch of salt

PROCEDURE

PROCEDURE

Combine the ingredients, chill, and carbonate with your method of choice.

Unclarified: Honeycrisp Rum Shake

Honeycrisps are one of the better new commercially available apple varieties. They are a wee bit low in acid, so this recipe requires extra acidity, in the form of either lime juice or straight malic acid. Apple juice is too diluted to work in a drink shaken with ice, so for this recipe you will do a juice shake (see the Alternative Chilling section, here) using frozen juice.

MAKES ONE 5.4-OUNCE (162-ML) DRINK AT 14.8% ALCOHOL BY VOLUME, 7.8 G/100 ML

SUGAR, 0.81% ACID

INGREDIENTS

- 2 ounces (60 ml) clean-tasting white rum (40% alcohol by volume)
- Short ½ ounce (12 ml) lime juice,
- or 0.7 grams malic acid dissolved in 10 ml water and 2 drops saline solution or a pinch of salt
- 3 ounces (90 ml) unclarified Honeycrisp apple juice frozen into three 1-ounce (30-ml) cubes

PROCEDURE

Combine the rum and the lime juice or malic acid and salt, then shake with the apple juice ice cubes in a cocktail shaker till the ice has completely melted to a slush (you can hear this happening). Serve in a chilled coupe.

Now let’s take a trip beyond the supermarket.

LEARNING ABOUT APPLES

We are living in a great time for apples, and interesting varieties are within everyone’s reach. If you don’t live near good growers, you can buy specialty apples directly from growers online. If you live in apple country, farmers’ markets have more varieties on display every year as more and more people express interest in fruit variety. You’ve got to get out and taste. You’ll find a list of critically important apple references in the bibliography, but remember that they are no substitute for your mouth.

CHOOSING AND TASTING APPLES

Whether you are choosing apples at the greenmarket or off the trees, keep a few pointers in mind. Bring a knife: it is much easier to get a good sense of how an apple really tastes by slicing off a piece of flesh and skin instead of sinking your teeth into a whole fruit, especially if you are tasting dozens of apples and you want to avoid sore gums. Remember that when you taste an apple for cocktails, the texture does not matter! Erase your perception of texture and focus only on how the juice tastes. This task is difficult at first. Practice.

HOW APPLE TEXTURE MATTERS FOR COCKTAILS

You wouldn't think an apple's texture matters for cocktails—after all, we are just going to juice them—but it does, indirectly. America's texture preferences have all but removed whole swaths of potentially good cocktail apples from contention. Let me explain.

We Americans are prejudiced. We accept *only* crunchy apples. This is not a good thing. Why must an apple be crunchy? Other textures, like crumbly, can be good too. We have lost the ability to distinguish between crumbly and mealy. A mealy apple is a formerly crunchy apple that has been stored too long and is losing quality. It is bad. A crumbly apple, however, is entirely different: one whose texture was never crunchy when ripe. Accept the beauty of difference.

How does this affect the quality of your juice? American growers planting heirloom varieties know you will buy only crunchy apples, so they often pick their fruit viciously underripe. Mature fruits would be unacceptably soft and wouldn't sell. These underripe apples are sad. They have very little of their characteristic varietal flavors. They are flat. They haven't developed their sugar yet, so they also taste like acid bombs and are full of unconverted starch. Picking underripe yields a crunchy apple that is flavorless, acidic, and starchy. Early-season apples are the biggest losers in this category, because as a group they are light in flavor to begin with, have a very short season, and turn mushy faster than any other apples do. It is almost impossible to get a grower to pick them for you when they are ripe.

As cocktail folks, we don't even care what the texture is—we are just making juice—but we still pay the price. Do your part and tell your local growers that if they pick apples when they are ripe, you'll buy them! Lots of them!

When you cut into an apple, feel how the knife moves through the flesh. You can sense the starchiness of an underripe apple even before you taste it: it feels like you are slicing a hard potato. You can see starch in the juice on the cut face of an underripe apple before you taste it. Avoid these apples. When you look at a bin of apples or a tree full of apples, look for two apples with different coloration. Even in apples that stay green forever, the color will change as the fruit ripens, usually getting darker or developing a blush. Even on a particular tree, apples will be in varying stages of ripeness depending on where they are. And beyond simple ripeness, the flavor of an apple can change depending on how much sun it gets compared to others on the tree and how far down the branch it grows. Tasting the two most differently colored apples of a variety will show you the range of flavors a particular apple is likely to have. On an individual fruit, look for one side that is more colored than another or that has a blush on it. First taste the side farthest from the blush. Hopefully it is good. Now taste the side with the blush—it will be richer, sweeter, more sun-kissed. The juice from that apple will be in between the two tastes.

The blush side of an apple tastes different.

After you perform these tests, take only the apples that fit your requirements. In an orchard this is easy, and in a market it isn't too difficult. Just buy two different apples from each variety that interests you, taste them on the spot, and then buy however many you need for cocktails. Remember that apple juice freezes well: if you find an apple that you love, buy a bunch, then process and freeze.

SUGAR AND ACID

Apples that do well in cocktails tend to be high in both sugar and acid. Low-sugar apples are rarely good because they are mostly underripe, so they will also have little flavor, not just low sugar. High-acid juice is good, because it allows you to make a cocktail without any other added acid. Low-acid apples can be greatly improved by adding a little acidity, in the form of straight malic acid, lemon or lime juice, or even acidic alcoholic ingredients like vermouth. But I prefer to use apples that don't require too much adjusting, allowing you to present the pure flavors of the apple without distractions.

Commercially, especially in hard-cider production, people will quote apple varieties based on the sugar-to-acid ratio. This enables you to judge the balance of a juice based on one number. You can then look at the sugar level (usually quoted in Brix) to determine the overall taste strength of the juice. Most people won't have refractometers to measure their juice, and fewer still can adequately measure the acidity of their apple juice (pH meters won't work for this), but many benchmarks for particular varieties can be found online and are useful guidelines for choosing which apples to test if you can't taste them before you buy.

For cocktails, I like apple juice with a sugar-to-acid ratio between about 13 and 15; 13 is tart, 15 pleasantly acidic. For reference, Granny Smiths are about a 14. Gala apples, which are low in acid and fairly sweet, clock in around 21. As for sugar levels, apple juice should be above 11 Brix to be useful, and is better around 14 or 15—as sweet as or sweeter than soda.

Let's look at some cocktail experimentation with two high-sugar, high-acid apples: Ashmead's Kernel and the Wickson crabapple.

OVERRIPE AND OVER-THE-HILL APPLES

You want to avoid apples that have languished. In a market, you can tell which apples are past their prime because they no longer feel hard in the hand; maybe they have even shriveled a bit. In an orchard, feel the apples. If they feel greasy, this is a sign that they are overripe; the naturally occurring epicuticular wax coating on many apples gets greasier as they ripen. (In the grocery store this test is not so useful: the grower may have removed the natural coating during washing and put a different one on top.) If you suspect an apple is overripe, cut it open. Many overripe apples develop water core, a wet-looking inside that appears as though it has been frozen and thawed. Usually, but not always, overripe apples will be softer than they should be.

Overripe or overstored apples are no good for eating, but mildly overripe apples can make for an interesting cocktail ingredient. As they overripen, apples lose acidity, so overripe apples will always need more acid correction than properly ripe ones will. They can also develop very intriguing perfumey floral aromas as the ethylene gas in the apples kicks into overdrive and produces volatile esters in the fruit. In small amounts these esters can be fabulous. In overabundance they make the apples smell of solvent. If you want to capture these flavors, beware: they are very fugitive.

ASHMEAD'S KERNEL

Ashmead's Kernel is a russeted, yellowish-skinned English apple dating back to the early eighteenth century. I get mine from a grower in New Hampshire. When these apples are good, they are really, really good. The juice just tastes rich.

Many russeted apples share a pearlike note, but with more acid; Ashmead's has a bit of that but is more full-bodied than usual. The Brix can approach 18, which is very high, and it has a high acid to match. I don't have any hard data on the sugar-to-acid ratio, but I'd guess it's around 14.

Ashmead's Kernel desperately wants to be paired with whiskey and carbonated, but for one sticking point: the oak in whiskey swamps the flavor of the apple. This problem eventually got me started on washing whiskeys (see here). But long before I tried to soften with washing, I solved the problem through simple redistillation in a rotary evaporator. This redistilled whiskey was clear and colorless but still very plainly whiskey. I simply mixed it with the clarified Ashmead's, softened the drink with a bit of water and a pinch of salt, chilled it, and carbonated it. The Kentucky Kernel, as I called it, is exactly the kind of drink I love to make: just two ingredients, manipulated and combined to create a flavor that people hadn't experienced before.

I first made that drink in 2007, with the very first batch of Ashmead's Kernel that I swiped from the U.S. apple collection in Geneva. Now that I have a bar, I can't distill anymore (pesky legal issues), so I can't make my Kentucky Kernel the way I used to. The answer, as you know by now, is washing the whiskey. Here is the recipe:

Kentucky Kernel

MAKES ONE 5.25-OUNCE (157.5-ML) CARBONATED DRINK AT 15% ALCOHOL BY VOLUME, 8.6 G/100 ML SUGAR, APPROXIMATELY 0.6% ACID (ASSUMING YOUR BATCH OF APPLES HAS AN ACID-TO-SUGAR RATIO OF 14; YOU'LL HAVE TO TASTE YOUR APPLES TO SEE IF YOU NEED TO ADJUST MY RECIPE)

INGREDIENTS

$1\frac{3}{4}$ ounces (52.5 ml) chitosan/gellan-washed Makers Mark bourbon (45% alcohol by volume)

$2\ \frac{1}{2}$ ounces (75 ml) clarified Ashmead's Kernel juice

1 ounce (30 ml) filtered water

2 drops saline solution or a pinch of salt

PROCEDURE

Combine the ingredients, chill, and carbonate. Serve in a chilled flute.

That recipe is equally delicious made with de-oaked Cognac instead of bourbon. If the oak is still too strong for you, you can try egg washing (see the Booze Washing section, here).

BOTTLED CARAMEL APPLETINI TWO WAYS, AND THE AUTO-JUSTINO

The Wickson crabapple is not really a crabapple at all. It has an illustrious and definitely uncrabby parentage, and is called a crab simply because it is very small. From what I can gather, it is a cross between the Newtown Pippin, the first apple America exported to Europe in colonial times (discovered in New York), and the Esopus Spitzenburg, another fabulous and famous colonial-era American apple (also from New York State), with which I have made many good cocktails. Discovered in California in 1944, the Wickson packs a wallop in a tiny package. It can reach over 20 Brix, although the ones I get are closer to 15. The acid level can reach 1.25 percent. These are great levels for cocktail work, and it has a great flavor as well, rich and round. I decided to make appletinis.

The appletini, as you are no doubt aware, has a well-deserved bad rep attributable to the fake sour-green apple schnapps of which it is typically constructed. The Wickson has the acidity and sugar to pull off a beautifully refined appletini, one you can be proud to order. You could make this drink with a mixture of Plymouth gin and vodka, but I stick with the pure vodka here, and finish with Dolin Blanc sweet white vermouth. I also mess with the Wickson a little: I decided to produce a caramel-apple flavor for a nice fall tribute, so I add a little bit of caramel syrup.

If you stir this drink, it will get too diluted. Instead, make it as a bottled cocktail (see the Alternative Chilling section, here). If you fill the bottles with the mix, purge the headspace of oxygen using liquid nitrogen and cap them; they should last a long time. I store them at exactly 22°F (–5.5°C)—service temperature—in my Randell FX freezer. If all you have is a home freezer, let the bottles freeze! Just don’t overfill them, or they’ll explode when they freeze. When it comes time to serve, run the bottles under water till they just thaw out. This isn’t the procedure I give for making bottled cocktails in the Alternative Chilling section; it is a slightly different technique based on the principles outlined in that chapter. I present it this way to show that you needn’t follow any technique dogmatically. I don’t. You can take advantage of any of the techniques in this book using whatever equipment you have at hand, once you grasp the principles.

This drink could also be bottled and chilled for service in a salt-ice bath.

Bottled Caramel Appletini

My Wicksons were 15 Brix. If yours are higher (many reported measurements are over 20), you will have to adjust your recipe or it will become toothachingly sweet. You don't need a refractometer to figure this out. If the drink is too sweet, adjust! This drink is not supposed to be a sugar bomb. Caramel syrup isn't as sweet at the sugar it contains, because some breaks down during caramelization.

MAKES ONE $5\frac{1}{5}$-OUNCE (155-ML) DRINK AT 16.5% ALCOHOL BY VOLUME, 7.2 G/100 ML SUGAR, 0.45% ACID

INGREDIENTS

2 ounces (60 ml) vodka (40% alcohol by volume)

$\frac{1}{4}$ ounce (7.5 ml) Dolin Blanc vermouth (16.5% alcohol by volume)

1 ounce (30 ml) filtered water

$1\frac{3}{4}$ ounces (52.5 ml) clarified Wickson crabapple juice

1 bar spoon (4 ml) 70-Brix caramel syrup (see Note)

NOTE: For 70-Brix caramel, add a small amount of water—around 1 ounce (30 ml)—to the bottom of a pan. On top of the water pour 400 grams of granulated sugar and heat till the mixture forms a rich, dark caramel, almost but not quite burned. Immediately add 400 ml of water. It will boil violently. Stir the mixture with a spoon to dissolve everything. After the syrup cools, measure the Brix. It should be somewhere between 66 and 70. If it is higher, add water. If lower, boil some water off.

Dash of orange bitters (preferably the recipe here)

2 drops saline solution or a dash of salt

PROCEDURE

Mix everything together, bottle, chill, and serve.

I promised you an appletini two ways, and for the second way I developed a new technique. At the beginning of this section I mentioned that clarifying an apple really removes some of the flavor from the juice. I wondered if I could get some of the unclarified pulpy flavor in a clear drink. I decided to add alcohol to the cloudy juice in hopes that the liquor would pull some of the flavor out of the pulp that would otherwise be lost when I clarified. I also decided to use very high-proof liquor, because I wanted the resulting liquid to be shelf-stable, similar to the Justinos I describe in the Clarification section. I added 400 ml of pure ethanol (the lab-grade stuff I have mentioned) to 600 ml of cloudy juice, with no added clarification enzymes. Something fantastic happened. The ethanol did in fact pull some good flavor out of the pulp. But this surprised me: the high-proof booze instantly caused the pectin in the apple juice to aggregate and auto-clarify. No waiting, no centrifuge, just crystal clear—and delicious! I call this the Auto-Justino. The Auto-Justino is shelf-stable and a bit over 40% alcohol by volume. Just add Dolin Blanc and bitters and stir it into an appletini. You can also use the Wickson Auto-Justino in shaken drinks. Although most of the pectin in the Auto-Justino aggregates and is strained out, there is enough residual pectin in the booze to make a nice layer of foam on top of a shaken drink.

This Auto-Justino was made from Ashmead's Kernel and aged for several months.

The real problem with this technique is that good-quality, 96% or higher alcohol by volume liquor is hard to get, and the bad stuff smells like a hospital and tastes like poison even after it has been diluted. To see if the technique would work on lower-proof stuff, I tested a fifty-fifty mix of Bacardi 151-proof aged rum (75.5 % alcohol by volume). It worked fantastically well, and the resulting liquor was still above a respectable 37% alcohol by volume. I was surprised at how good the Bacardi tasted with the apple. I'm pretty sure the 151 is a stunt liquor built to fuel frat-party nonsense—it comes with flammability warnings and a metal antiflame pouring screen—but it is surprisingly well crafted.

The 151 at 75.5% alcohol by volume is near the lower limit of alcohol content for success with this technique; 57% alcohol by volume was a failure. If you can find even small amounts of tolerable 96% alcohol-by-volume booze, you can use it to fortify high-quality flavorful liquors up above 70% alcohol by volume for this technique. One such mix: 25% gin (47.5% alcohol by volume or above), 25 percent of the 96 percent alcohol by volume, and 50 percent juice.

When you make an Auto-Justino, you should use a spoon to gently mix the liquid around, coaxing the pectin globs closer to each other and allowing them to swab up stray cloudy bits in the liquid, polishing the liquor.

The Auto-Justino has lots of advantages: it is fast, it requires no equipment (except the juicer to make the apple juice), and it extracts good flavor from the pulp. This technique relies on the fact that apple juice contains pectin but is still rather thin. I tried it on thicker purees like strawberry without success.

FUTURE EXPLORATION

Plenty of mid-and late-season apples make great cocktails—dozens at least that any reader of this book in a temperate climate zone can get his or her hands on. Much more difficult is making a great cocktail with very early-season apples, like Yellow Transparent and Lodi. They are tough customers. They have very little flavor. They are called salt apples by some old-timers, who like to sprinkle them with salt and eat them less as a dessert-style snack and more as a savory, salty, refreshing-style snack. I have not yet successfully made a great cocktail with these apples. I think I haven't yet fully listened to what they are trying to tell me. I haven't figured out what they want to be yet, but I get closer every year. My guess is light, salty, and fleeting, maybe using agave for its here-and-gone fructose hit, and gin. Maybe I'll crack the code next year. I've had early-season apples that would be great in cocktails, but I haven't been able to source them regularly. I once got a shipment of Carolina Red June and Chenango Strawberry apples from Virginia. Blended together, they were the best early-season juice I've ever made, but I've never had enough to really test.

I have yet to explore the possibility of using highly tannic cider apples as a component of a cocktail—a ridiculous oversight you can be sure I will rectify next season. When you taste one of these apples in an orchard, you spit it out straightaway. In fact they are called spitters. My brain never got over the prejudice of not liking them in the orchard so I could see how they may be useful in a cocktail, or how they might taste after I remove some of the tannin with milk/egg/chitosan washing.

Last, I would love to travel to Kazakhstan, the home of the apple, to the Tien Shien fruit forest. By all accounts, this forest, stretching from Kazakhstan to western China, is an amazing place. Most fruits in their wild state are not nearly as good as their bred and domesticated counterparts, and many people think this is true of the apple—but no. Phil Forsline, the curator of the U.S. apple collection when McGee and I visited in 2007, had made a pet project of gathering wild apples from the Tien Shien forest. McGee and I tasted some of those wild apples and they were quite good, worthy of being named. Perhaps I could wander in that forest till I found a wild apple tree whose fruit had the rich taste, high acid, and high sugar necessary for good cocktail work. Then I'd have a variety I could literally call my own. That would be fun cocktailing.

Coffee

I have spent most of my life hating coffee and referring to it as an execrable, thin, bitter liquid. When I was growing up, my mom’s favorite nighttime tipple was Kahlua and milk; even in that highly sugared state I couldn’t stand it. I satisfied my college and grad-school caffeine needs with tea and Diet Coke.

In my late twenties, I decided things were going to change. I was going to like coffee, and I was going to like it strong. I forced myself to down shots of espresso. After a couple of weeks I learned to like it—then love it. I soon decided I needed pro espresso at home, but I couldn’t afford a good machine. I started trolling restaurant auctions. I struck gold at a place that, after a DEA raid, had had the door padlocked for weeks with rotting food inside. Since I was one of the few prospective buyers willing to stand the stench during the auction, I left with a sweet eighties-vintage two-group Rancilio for just a hundred bucks. Thus began my many years’ journey into the world of espresso.

Pulling an espresso shot.

That was in the late 1990s. The state of espresso art has come a long, long way since then, and many smart people have committed many years of study to that little brown shot. This is a book on cocktails, not coffee, so I'll avoid the nitty-gritty here, but I do want to walk you through my approach to a challenge I set for myself: to make a coffee cocktail that captures what I like about espresso in cocktail form. These cocktails don't necessarily contain espresso; they just embody what is great about it.

A quick note on other coffee forms: I have not been able to get excited about drip coffee, iced coffee, or coffee with milk. I don't like coffee-flavored things, even coffee ice cream. I'm not telling you this because I'm proud of it—I just want you to know my proclivities so you can better judge the rest of this section.

ESPRESSO CHARACTERISTICS: WHAT WE ARE AIMING FOR

For the purposes of this discussion, I define espresso as 1½ ounces (45 ml) of coffee brewed from 15 grams of compacted freshly ground coffee in 22 seconds using 92°C (198°F) water at a pressure of 135 psi (9.3 bars). I use more coffee grounds and less water than a traditional northern Italian would, and fewer coffee grounds and more water than a modern American barista would. Feel free to disagree with my ratio.

Espresso should be strong and pleasantly bitter, but not acrid. It shouldn't require sugar. So I want my coffee cocktail to taste strongly of coffee, and to avoid acridity and sweetness.

The high pressure under which espresso is brewed causes a foam, called crema, to form on top. The bubbles that form this foam are actually present throughout the shot. The high pressure also causes coffee oils to emulsify into the liquid (espresso, unlike drip coffee, is an emulsion). Foaming and emulsification give espresso its characteristic opacity, body, and texture. The texture of espresso dies fairly quickly, just as the texture of a shaken cocktail does. So to recreate the body of espresso in a cocktail, we definitely won't be stirring—stirring is for limpid drinks, and we are aiming for exactly the opposite. We will need to use shaking and carbonating to get the texture I'm after.

ESPRESSO DRINKS THAT ACTUALLY INCLUDE ESPRESSO

Espresso is an ideal cocktail ingredient, because it delivers its substantial flavor in small, cocktail-sized doses. Drip coffee cannot compete with espresso in cocktails; it carries too much water with it. If you try to make drip coffee strong enough to stand up to dilution, it becomes acrid. You might think that cold-brew coffee concentrate, which has become popular recently, is a good substitute: like espresso, it is bitter without being acrid. But the taste just isn't the same.

Using espresso instead of drip coffee takes care of our first coffee-cocktail criteria: strong but not acrid. To help us tackle the tougher problem, texture, let's take a quick look at iced coffee.

ICED ESPRESSO

Iced coffee is one of the few things I make a lot of, even though I loathe it. My wife loves iced coffee and cannot understand my contempt. In an attempt to make an iced coffee we both would like, I focused on improving its texture. Simple shaking was the answer. Espresso shaken with ice and a little sugar—a *caffè shakerato* in Italy—textures very nicely but must be consumed very quickly. Add milk and your texture problem is gone completely. Milk is a foam-making machine. A shaken iced espresso with milk is a pretty good drink, even for haters. If you don't try any other recipe in this book but you like an iced coffee, please try this one. Your life will be better for it!

Shakerato with Milk

MAKES ONE 6⅔-OUNCE (197-ML) DRINK 0% ALCOHOL BY VOLUME, 4.7 G/100 ML SUGAR, 0.34% ACID

INGREDIENTS

1½ ounces (45 ml) freshly made espresso cooled down to at least 60°C (140°F)

3 ounces (90 ml) whole milk

½ ounce (15 ml) simple syrup

2 drops saline solution or a pinch of salt

Copious ice

PROCEDURE

Combine the ingredients and shake like the devil. Either strain and serve in a chilled glass or serve it in a tall glass with some ice and a long straw. If you prefer a no-milk version, omit the milk, shake a bit longer, and serve in a chilled coupe glass.

ALCOHOLIC ICED ESPRESSO

Adding liquor to a shakerato throws off the dilution and body. To get the right texture with liquor, I suggest substituting cream for milk and letting the espresso chill a bit more.

Boozy Shakerato

MAKES ONE $7\frac{4}{5}$-OUNCE (234-ML) DRINK AT 10.2% ALCOHOL BY VOLUME, 3.9 G/100 ML SUGAR, 0.29% ACID

INGREDIENTS

$1\frac{1}{2}$ ounces (45 ml) freshly made espresso cooled down to 50°C (122°F)

2 ounces (60 ml) dark rum (40% alcohol by volume; nothing too funky)

1½ ounces (45 ml) heavy cream (you can use light cream or even half and half if you prefer, but the drink won't be as good)

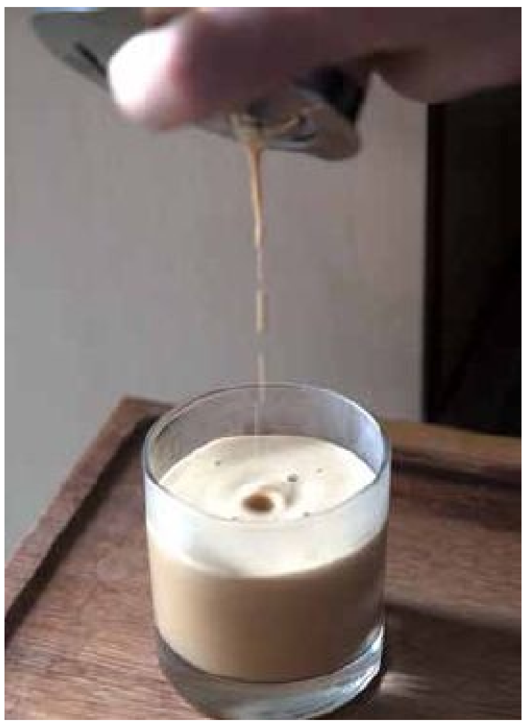
½ ounce (15 ml) simple syrup

2 drops saline solution or a pinch of salt

Copious ice

PROCEDURE

Combine the ingredients and shake. Strain into a chilled double old-fashioned glass (the volume is too much for a coupe).



Boozy Shakerato with cream, shaken with regular ice.

Boozy Shakerato with milk—no cream.

Boozy Shakerato 2

Another option to keep the texture without adding cream: freeze milk into ice cubes and shake with them. This is a variant of the juice-shake method in the Alternative Chilling section, here.

MAKES ONE 7½-OUNCE (225-ML) DRINK AT 10.7% ALCOHOL BY VOLUME, 4.1% G/100 ML SUGAR, 0.3% ACID

INGREDIENTS

1½ ounces (45 ml) freshly made espresso cooled down to 50°C (122°F)

2 ounces (60 ml) dark rum (40% alcohol by volume; nothing too funky)

½ ounce (15 ml) simple syrup

2 drops saline solution or a pinch of salt

3½ ounces (105 ml) whole milk, frozen into ice cubes

PROCEDURE

Combine the liquid ingredients and shake with the frozen milk cubes until all the

Combine the liquid ingredients and shake with the frozen milk cubes until all the ice has broken into slush. You should be able to hear the slushiness in your cocktail shaker. Strain into a chilled double old-fashioned glass (the volume is too much for a coupe).

Boozy Shakerato 2 made with milk ice cubes.

TEXTURE WITHOUT SHAKING: BUBBLES

Espresso starts out as a drink full of bubbles—carbon dioxide bubbles, in fact. When coffee is roasted, carbon dioxide generates inside the beans. When you force pressurized water through the coffee grounds, the CO_2 dissolves into the brew water. When the hot water reaches atmospheric pressure, the dissolved CO_2 bubbles out like it does in a foaming bottle of warm soda, causing espresso to foam. As coffee beans age and go stale, their CO_2 depletes, making them taste bad and taking away their texturizing powers.

Since the bubbles in espresso are just CO_2, why not just carbonate a chilled espresso cocktail to get the texture I want? Because carbonated coffee tastes weird, that's why. (You can buy a coffee soda called Manhattan Special that appeals to some people—I'm not among them.) The amount of CO_2 in an espresso is small because the brew water is so hot; remember, the amount of CO_2 soluble in a liquid is inversely proportional to its temperature. You'd never describe espresso as tasting carbonated, right? To get bubbles without the prickly taste of CO_2, use nitrous oxide (N_2O), which creates bubbles much like CO_2 but tastes sweet instead of prickly.

I have a big nitrous oxide tank, so I can make drinks with N_2O the same way I would with CO_2. Most of you, except for the dentists, will not be able to buy it in large quantities. Luckily, N_2O is easy to purchase in cartridge form; refer back to the Rapid Infusion section, here. So let's make this drink in an iSi whipper.

Nitrous Espresso

Be aware that espresso foams like a demon when you add bubbles to it, so though you can make two drinks at a time, be careful not to overfill your whipper. Also note that nitrous is sweet, so as this drink sits around in the glass and the nitrous bubbles off, it will taste progressively less sweet. If you swish a nitrous drink around in your mouth before you swallow, it will give you a burst of sweetness as more nitrous is released from the liquid. Although for consistency I give the recipe for a single drink, this recipe is best doubled.

Makes one 5-ounce (165-ml) drink at 12.7% alcohol by volume, 5.6% g/100 ml sugar, 0.41% acid

INGREDIENTS

$1\frac{1}{2}$ ounces (45 ml) espresso

$1\frac{3}{4}$ ounces (52.5 ml) vodka (40% alcohol by volume)

$\frac{1}{2}$ ounce (15 ml) simple syrup

$1\frac{3}{7}$ ounces (52.5 ml) filtered water

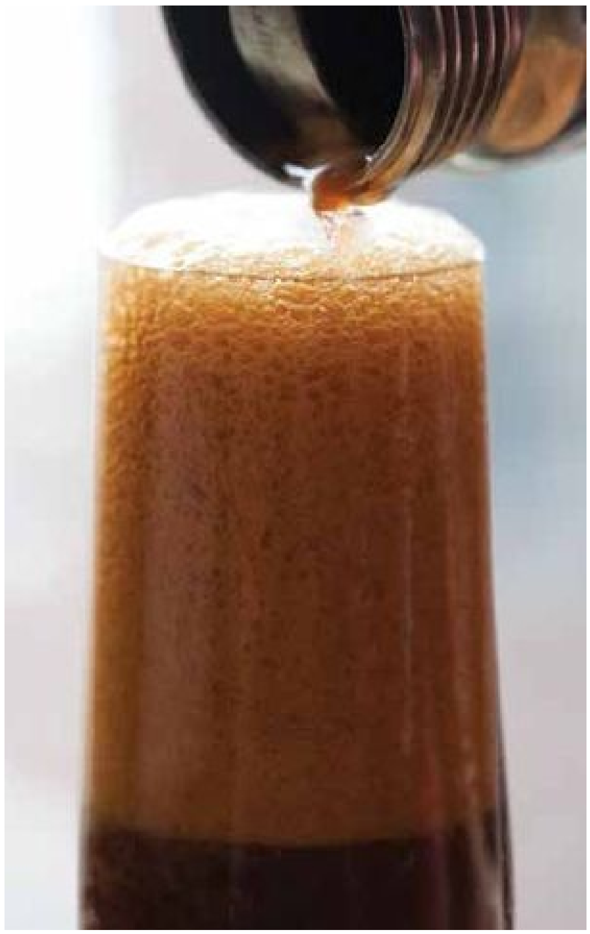
2 drops saline solution or a pinch of salt

EQUIPMENT

Two 7.5-gram N_2O chargers

PROCEDURE

Combine all the ingredients in the iSi whipper and chill in the freezer till it is just about to freeze (this will also chill your whipper). Close the whipper and charge with an N_2O charger. Shake and then vent while holding a towel over the nozzle to deaerate the drink (try not to spray coffee everywhere; believe me, it is messy). Now charge with a second charger and shake for at least 12 seconds. Put the whipper down and let it remain undisturbed for around 90 seconds. Slowly—I mean slowly—vent the whipper. You are trying to preserve the bubbles here. Serve in a chilled flute glass.



ESPRESSO DRINKS THAT DON’T ACTUALLY CONTAIN ESPRESSO

Early in my cocktail experimentation I became interested in distillation as a method for preserving aroma while removing bitterness. I attempted to make a coffee liquor with no bitterness and therefore no need for sugar. I had no success at all. None of the distillations I made, whether I used grounds or brewed coffee, tasted remotely like good, strong coffee. Turns out coffee flavor is not recognizable without all the bitter, heavy stuff that doesn't distill.

When distillation failed I turned to infusions, but nothing ever tasted quite right . . . until I developed rapid nitrous infusion. Without rapid infusion, my coffee concoctions were too weak or had a lingering, unpleasant, bitter aftertaste. Rapid infusion allowed me to make a coffee infusion that *acted* like espresso, with a pure, strong coffee taste, the pleasant bitterness of coffee, and no acridity. This liquor required only a modicum of sugar when used in a cocktail. The only problem with my coffee infusions now: they still required milk to achieve the right texture. You can guess how I felt about that. My second breakthrough came with the milk-washing technique (revisit the Milk Washing section, here). With milk washing you add milk to liquor, allow or force the milk to curdle, and then strain out the solids. The resulting liquors still contain whey proteins and make nice creamy, foamy drinks, but they don't taste milky.

COFFEE ZACAPA COCKTAIL

Finally! A cold coffee drink I really enjoyed. The recipe below is a variation of the one in the Rapid Infusion section, in which I use djer, a West African spice, to make Café Touba (here). The liquor base is aged rum. First the infusion:

INGREDIENTS FOR COFFEE ZACAPA

750 ml Ron Zacapa 23 Solera rum, divided into a 500 ml portion and a 250 ml portion

100 ml filtered water

100 grams whole fresh coffee beans roasted on the dark side

185 ml whole milk

Citric acid or lemon juice, if needed

PROCEDURE

Grind the coffee in a spice grinder until it is slightly finer than drip grind. Combine 500 ml rum and the coffee in a half-liter iSi whipper, charge with one charger, shake, and then add a second charger. Shake for another 30 seconds. Total infusion time should be 1 minute 15 seconds. Vent. Unlike most infusions, don't wait for the bubbling to stop, or the liquor will be overinfused. Instead rest for just 1 minute, then pour through a fine-mesh filter into a coffee filter. If you pour the mixture directly into a coffee filter it will probably clog very quickly. The mixture should filter within 2 minutes. If not, your grind was too fine. Combine and stir the drained grounds in the coffee filter, then add the water evenly over the grounds and let it drip through (this is called sparging). That water will replace some of the rum that was trapped in the grounds during the infusion. The liquid that comes out of the grounds from sparging should be about 50 percent water and 50 percent rum.

At this point you should have lost roughly 100 ml of liquid to the grounds. About half of that lost liquid is water and the other half rum, so your final product has a slightly lower alcohol by volume than you started with.

Taste the infusion. If it is strong (which is good), add the additional 250 ml of rum to the liquor. If the infusion can't bear to be toned down without losing the flavor of the coffee, your grind size was too coarse; don't add any more rum, and reduce the amount of milk you use for milk washing to 122 ml.

While stirring, add the coffee rum to the milk and not the other way around, lest the milk instantly curdle. Stop stirring and allow the mixture to curdle, which it should do within about 30 seconds. If it doesn't curdle, add a little 15% citric acid solution or lemon juice bit by bit until the mixture curdles, and don't stir when it's curdling. Once the milk curdles, gently use a spoon to move the curds around without breaking them up. This step will help capture more of the casein from the milk and produce a clearer product. Allow the mix to stand overnight in the fridge in a round container; the curds will settle to the bottom and you can pour the clear liquor off the top. Strain the curds through a coffee filter to get the last of the liquor yield. Alternatively, spin the liquor in a centrifuge at 4000 g's for 10 minutes right after it curdles. That's what I do.

APPROXIMATE FINAL ALCOHOL BY VOLUME: 35%
MAKES ONE 3⁹⁄₁₀-OUNCE (117-ML) DRINK AT 15.8% ALCOHOL BY VOLUME, AND 7.9% G/100 ML SUGAR, 0.38% ACID

INGREDIENTS FOR COFFEE ZACAPA COCKTAIL

2 ounces (60 ml) Coffee Zacapa

½ ounce (15 ml) simple syrup

2 drops saline solution or a pinch of salt

Ice

PROCEDURE

Shake all the ingredients in a cocktail shaker and strain into a chilled coupe glass. The drink should be creamy and frothy.

FUTURE STEPS

I'd like to revisit coffee distillation; I have not tried since my first ill-fated attempts. It might be possible to create a supercoffee liquor by first distilling liquor with coffee and then infusing that same liquor with coffee grounds—a double coffee effect.

I'd like to experiment with altering the espresso-brewing procedure specifically for cocktails. The amount of foam in an espresso is dependent, as we discussed, on the amount of CO_2 in the roasted beans. The darker the roast of the coffee, the more CO_2 is present, hence more foam. The foam in espresso has greater stability, however, if you use medium-roasted coffee, so I'd like to use a medium-roasted coffee and supplement the CO_2 during the brewing process. If I'm lucky, this will let me brew a 1½-ounce shot of espresso directly into an ounce shot of liquor to produce hot espresso shots with good texture. At home, my espresso machine is plumbed to my filtered water supply, as is my carbonator. It would be fairly simple to hook the output of my carbonator to the input of my espresso machine. If I brew with carbonated water, I should get more foam—I hope. My espresso machine uses a heat exchanger to heat the brewing water, which means that the water used for brewing goes from room temperature to hot very quickly and is under the full 135 psi (9.3 bars) of pressure the entire time it is being heated and delivered. It just might work.

I'd also like to experiment with brewing hot cocktails directly, using booze mixed with water in an espresso machine. It might be good or it might be terrible. I know I'll learn a lot trying.

The Gin and Tonic

I am ending this book where my own cocktail journey began: with the gin and tonic. It's the first drink I remember my dad making. He would fix one for himself and a tonic with lime for me. The first cocktail I analyzed closely, the G&T inspired me to develop many of my cocktail techniques. I still think about it daily. The gin and tonic repays deep thought.

The gin and tonic is seemingly so simple: gin, tonic water, and a squeeze of lime. The promise of the G&T is so great: crisp and refreshing, on the dry side, a bit tart, slightly bitter, aromatic, crystal clear with lots of bubbles. But G&Ts almost always disappoint. Sometimes there's too much gin, and therefore too little carbonation. Sometimes there's too little gin, and therefore too few aromatics and too much sweetness. All too often, warm gin and tepid tonic water are poured over copious quantities of watery ice, producing a drink tasting mainly of water. How could something so simple in concept be so difficult in practice? The answer is simple. It is *impossible* to make a good gin and tonic using traditional techniques. Yes, impossible. There is *no* ratio of gin to tonic with the right balance of flavors and enough carbonation. You may postulate that I am an outlier, that I was ruined by years of drinking straight tonic water with my dad. But I think if you search your heart, you will agree that you too are unsatisfied with the bubbles in a traditional gin and tonic, even if—or especially if—the G&T is one of your favorite drinks.

THE BEST G&T YOU CAN MUSTER IF YOU CAN'T MUSTER MUCH

The best gin and tonic you can make with traditional techniques uses gin that you've stored in your freezer and tonic water poured from a fresh bottle that you've kept in ice water (if you really must, use tonic water that has merely been refrigerated, but keep it in the coldest part of your fridge—the part that accidently freezes the lettuce from time to time). By "fresh bottle" I don't just mean unopened, I mean recently purchased. Plastic bottles lose their carbonation at an alarming rate, and smaller bottles lose carbonation faster than larger ones. Twenty-ounce bottles can lose an appreciable amount of carbonation in a month at room temperature. If you buy tonic amount of carbonation in a month at room temperature. If you buy tonic water in glass bottles or cans—both of which are gas-impermeable—storage time isn't important.

Before you make the drink, you must decide what glassware to serve in. For my G&Ts I typically choose a champagne flute (and no ice), but I am always using force carbonation. In this nonforce scenario, the champagne glass feels wrong, and it's best just to serve the drink on the rocks in a standard highball glass. You will add 1¾ ounces (52.5 ml) of gin and 3¼ ounces (97.5 ml) of tonic water to the glass to make a 5-ounce (150-ml) drink. You can measure the gin with a jigger, but don't measure the tonic water that way—jiggering will cause too much carbonation loss. Instead, before you make your drink measure 5 ounces (150-ml) of water into the glass and note where the water level, or wash line, is. Try free-pouring water into the glass to that same level by eye and then measure afterward how accurate you were. After a couple attempts you will likely be getting to within a quarter-ounce or better every time. You can also try to learn where the wash line for 1¾ ounces is in your glass so you can free-pour the gin, but I'd just use a jigger instead. Now you are ready to make the drink.

HARD WORK FOR THE LAZY DRINKER—THE NO-TECH GIN AND TONIC: 1) *Pre-freeze your glass and gin and pour the gin into the glass.* ***2)*** *Tilt the glass and pour in fresh, ice-cold tonic water.* ***3)*** *Now squeeze in some fresh lime and* ***4)*** *gently place in un-tempered freezer ice.* ***5)*** *Place the lime on top and drink it, lazy head.*

Several minutes before drink time, make sure your glass is in the freezer getting cold. Cut your lime into quarters, of which you will need one per drink. At drink time, pull the glass and gin out of the freezer and pour 1¾ ounces (52.5 ml) of gin into the glass *before you pour in the tonic*. Next, tilt your glass to a 45-degree angle and slowly pour the ice-cold tonic water into the glass. As you pour, slowly raise the glass to vertical and stop pouring when you have reached the 5-ounce (150-ml) wash line you memorized earlier. The order of operations is important. You want the two ingredients to mix thoroughly without any bubble-liberating activities like stirring. Pouring the tonic into the gin mixes better than pouring the gin into the tonic. Tonic water is denser than gin (even gin at freezer temperature), so the tonic will sink through the gin. Also, there is more tonic in the recipe than gin, and when mixing two liquids you'll mix more efficiently if you add the larger volume of liquid to the smaller one. As a bonus, adding gin to the glass first will melt any errant ice crystals on the inside of the glass—crystals that would become bubble nucleation sites and cause copious foaming if the tonic hit them.

Next, squeeze as much juice as you'd like into the drink from a quarter of a lime. Adding lime before tonic would help the drink mix better, but lime juice contains bubble nucleation sites and bubble-stabilizing surfactants that would wreak havoc with the tonic's carbonation if it were added earlier.

Then add freezer-cold ice—not tempered ice. Don't drop the ice into the drink like a Neanderthal. Gently slide it in using a bar spoon. It's important that you add the ice last; if it goes into the glass before the liquids, it will promote foaming as the tonic is poured and will present a barrier to mixing. Added at the end, the ice *promotes* mixing. If you use ice directly out of your freezer, it will add very little additional dilution. The ice cubes will crack from thermal shock, but that's okay in this application. Drop the lime quarter into the top of the glass if you like that sort of thing. If you dropped the lime directly into the liquid, it would create constant bubble nucleation, but in our on-the-rocks scenario the lime will sit just above the drink, leaving bubbles unharmed and lending a nice aroma as the glass is raised to the lips.

If you have a Sodastream or some other force-carbonation apparatus, you can take this recipe— 1¾ ounces (52.5 ml) of gin and 3¼ ounces (97.5 ml) of tonic water—and put the mix in your freezer till crystals just begin to form, then force-carbonate per the instructions in the Carbonation section, here (for a Sodastream you'll have to double the recipe). In this case I'd serve the drink in a chilled champagne flute without ice—you've earned it. Squeeze the lime into the drink after you have poured it and do not put the lime into the flute unless you want to spoil your carbonation work. Clarify the lime juice first for an even better result.

THE WAY OF THE G&T

In 2005, I realized that I would never be satisfied with a traditional G&T. It was a profound moment. I learned that carbonation is an ingredient, and I knew I had to master carbonation so that I could separate the volume of tonic from the quantity of bubbles in the cocktail. I felt compelled to break down the entire gin and tonic and rebuild it from first principles. I won't go into detail on my carbonation travails here, because I discuss them ad nauseum in the Carbonation section. Let's talk about the other ingredients—the tonic water and the gin.

TONIC 101

Tonic water is a mixture of water, sweetener (usually high-fructose corn syrup in the United States), citric acid, quinine sulfate, and "flavors." Strangely, many people believe that tonic water is non-sweet and noncaloric, as seltzer water is. Not so. Tonic water is as sweet as soda, usually between 9.5 and 10 percent sugar by weight.

I like tonic water. I always have. I do not want to reinvent tonic or add new flavors to it. What I want is merely this: hyperfresh, hypercrisp, crystal-clear, and impeccably clean-tasting tonic—the second-most refreshing beverage in the world (behind seltzer).

THE QUININE

The ingredient that sets tonic water apart from other lemon-lime sodas is quinine, an intensely bitter plant alkaloid that fluoresces intensely under UV or black lights (a fact of which many a clubgoer is aware). Quinine comes from the bark of the South American cinchona tree and has been used as a medicinal herb in present-day Bolivia and Peru since before recorded history, and since the sixteenth century by Europeans as a malaria cure. Unlike many herbal remedies, which function primarily as placebos, quinine is a legit drug. It was immensely important to Europeans looking to subjugate malaria-ridden parts of the world in the 1800s. In the mid-nineteenth century people learned that taking small amounts of quinine weekly or daily protected against malaria, and tonic water was born. The amount of quinine in today's tonic water isn't enough to act as an effective prophylactic, but in some countries with malaria problems, as I witnessed firsthand in Senegal, people regularly consume tonic in hopes of avoiding the disease.

The papers I have read on malaria prophylaxis indicate that an effective daily dosage is around 0.3 grams of quinine sulfate. The U.S. legal limit for quinine sulfate in tonic water is 85 milligrams per liter, so you'd have to drink 3.5 liters for effective protection. That is a lot, and commercial tonic water usually has much less quinine than the legal limit would allow.

I wanted to get my hands on some quinine. I considered tracking down some cinchona bark, which is relatively easy to do, and steeping it, but decoctions of cinchona are brown and contain suspended detritus even after they are run through a coffee filter. Since my ideal G&T is crystal clear, this approach was not going to work. At the time of my early experiments I hadn't come up with any good clarification techniques, so I figured the bark would damage my carbonation. Quinine isn't the only substance in cinchona, so I was also pretty sure that I would introduce some unwanted nonquinine flavors. I decided I had to get the pure stuff.

QUININE SULFATE USP

Sourcing purified quinine wasn't easy. Quinine is sometimes used in the treatment of nighttime leg cramps, and until 1994 you could buy it over the counter for that purpose. At the time of my early experiments it was routinely prescribed by doctors. My mom is a doctor! No sweat! "No way," she said, without hesitation. Besides the obvious ethical violations, she said, there was no way she was writing me a prescription for a potentially harmful medicine that I planned to serve in a cocktail. Apparently consuming too much quinine causes a syndrome known as cinchonism, featuring nasty symptoms that range from simple nausea and dizziness, to the more frightening temporary hearing loss and blindness, all the way up to death from cardiac arrest or renal failure. Luckily, quinine is incredibly bitter and therefore almost impossible to overdose on accidentally—*if* it is used properly. You'd never willingly drink a cocktail with too much quinine in it, I pleaded. My mom (not surprisingly) turned a deaf ear. I ended up purchasing it from a chemical supply house. You must be extremely careful about what you purchase through a chemical supplier. Many chemicals come in different grades. If you are using a chemical for food or drink, it needs to be USP (United States Pharmacopeia)-grade, food-grade, or equivalent. Lower grades of chemicals can have dangerous impurities in them. This is a good across-the-board safety tip. Unfortunately, USP-grade quinine sulfate is expensive. As of this writing, 10 grams of the stuff will set you back almost a hundred bucks from a chemical supply house, and 100 grams will cost almost $500.

IMPORTANT QUININE SAFETY

Quinine is dangerous if used improperly. As little as one-third of a gram, the therapeutic dose for malaria prophylaxis back in the day, is enough to cause mild symptoms of cinchonism in some people. I will repeat that: one-third of 1 gram. **Never let anyone who isn't aware of the safety concerns work with quinine.** Quinine must be diluted before it's consumed. I predilute by making quinine simple syrup, and I use a scale accurate to one-hundredth of a gram. Unless you have a scale that is at least this accurate, you have no business working with quinine. After the quinine is diluted to a safe concentration, there is no real danger of overdose, unless some crazy person pounds a whole liter of your quinine simple syrup.

Once again: **do not attempt to use quinine in its undiluted powdered form**. The amount of powdered quinine you would want for a single drink is vanishingly small, nearly impossible to measure. Even if you could measure it properly, quinine tends to clump and is difficult to dissolve; the clumps can't be tasted if they don't hit your tongue, so they don't give warning of mismeasurement and potential overdose. You must check any quinine syrups you make to be sure all the quinine is completely dissolved, and pour them through a fine-mesh strainer as a final step.

USING QUININE AND CINCHONA

In my early experiments I made quinine water for cocktails so I could alter bitterness without altering any other components, such as sweetness and tartness. After years of honing my recipe, I now just add quinine directly to simple syrup. I find the syrup much easier to use, make, store, and dose. Here's my recipe:

Quinine Simple Syrup

MAKES 1 LITER

MAKES 1 LITER

INGREDIENTS

0.5 gram quinine sulfate USP

1 liter simple syrup (615 grams of water and 615 grams sugar mixed till the sugar is totally dissolved; note that these ingredients are given by *weight* but will produce 1 liter of syrup by *volume*)

PROCEDURE

Carefully weigh the quinine in a small, bone-dry, nonstick, and nonstatic-producing container. You don’t want any quinine sticking to your measuring container. Put the rest of the quinine away where no one will mess with it by mistake. Add the simple syrup to a blender and the quinine to the syrup while the blender is running. Let the blender blend for a minute or so on medium speed. Turn off the blender and wait for the bubbles to come out of the syrup solution. It should be clear, with no quinine specks left in it. If you still see white powder, blend some more. Strain the syrup through a fine strainer into a storage container.

Make the recipe as I have written it and experiment with it awhile before you change it. If you find my recipe too bitter for your taste, add regular simple syrup to it rather than making the recipe with less quinine. Measuring and dispensing less than 0.5 gram accurately can be tricky in bar environments. If you find that this syrup is not bitter enough, you have a more complicated problem. Half a gram grams of quinine sulfate per liter of simple syrup is right at the solubility limit of the quinine. You’d be hard-pressed to dissolve more in. You would have to make syrup that has less sugar in it than 1:1 syrup. Unfortunately, weaker syrups won’t have as long a shelf life.

The solubility limit of quinine is actually one of the beauties of this recipe. If you take all the precautions—visual checks, straining—it is very hard to overdose on the quinine using this recipe. The standard sweetness of tonic water is 10 percent sugar by weight, so a liter of tonic made with our syrup will have 170 ml (208 grams) of quinine simple syrup and therefore 0.069 grams of quinine—much less than the legal limit of .083 grams per liter. Even to approach the limit with this syrup, you’d have to make tonic water that was almost 13 percent sugar by weight, which would be unpalatably sweet.

If you'd rather not deal with quinine, you can work directly with cinchona bark instead, like this:

Cinchona Syrup

MAKES 1.2 LITERS

INGREDIENTS

20 grams (around 3 tablespoons) powdered cinchona bark (available online or at herbal shops; if you can't find powder, grind bark chips in a spice grinder)

750 ml filtered water

750 grams granulated sugar

PROCEDURE

Add the powdered bark to the water in a saucepan and bring to a simmer over medium-high heat. Lower the heat and simmer for 5 minutes, and then allow to cool. Strain through a fine strainer and then through a coffee filter. Press on the bark to extract liquid (or, as an alternative, spin the cinchona water in a centrifuge). Redilute the cinchona water to 750 ml (you will have lost some water in the infusion process) and add the sugar. Blend to dissolve.

CINCHONA BARK

WHERE THE QUININE COMES FROM IN COMMERCIAL TONIC WATER

A lot of people on the Internet claim that most quinine used in tonic is synthetic, and those same people would probably claim that the quinine I purchase from a supply house is synthetic as well. I cannot find one shred of credible evidence (that is, with a traceable source) that this is the case. Quite the opposite. Everything I have read indicates that extracting quinine from cinchona bark is still the cheapest method of production. Do you think beverage companies would pay more for a synthetic product? I don't.

THE LIME AND THE GIN

In addition to quinine and sugar, tonic water contains citric acid and "flavors." To my palate, those flavors are merely lime, or possibly lemon and lime. One of my big gripes with commercial tonic water is the lameness of the citrus flavor.

After I tackled quinine, a more difficult problem came into focus: the lime. Back in 2006 I had no good way to carbonate liquids containing juice. I hadn't yet developed any of my clarification techniques, so I could only use freeze-thaw gelatin clarification, which took several days to complete, or old-school consommé-style clarification, which involved boiling. Neither was okay. Lime juice must be used the day it is juiced, and it should never be heated.

I was experimenting with low-temperature vacuum distillation in a cobbled-together rotary evaporator, so I tried to distill the flavor of fresh limes at room temperature. I distilled straight lime juice, lime juice with peels, and both of those mixed with gin. I liked the distillates better without the peels, but the real discovery was that lime distilled with gin was infinitely better than lime distilled on its own, because ethanol is much better at holding on to volatiles than water is. (Years later I found the secret to distilling top-notch flavors without ethanol: a liquid nitrogen condenser. LN freezes all the volatiles on the condenser and captures them. But that discovery was far in the future.) My ability to preserve all the flavors that I was boiling off in my homemade vacuum was pretty poor, so I soon upgraded to a 1980s-vintage rotary evaporator, sourced on eBay for a couple hundred bucks.

That rotovap furthered my lime and gin distillation efforts immensely. When it arrived, it was filthy and smelled of carbon tetrachloride. (At least, it smelled like my memory of carbon tetrachloride. My high school chemistry teacher, Mrs. Zook, kept a stash of it for her favorite students' experiments with nonpolar solvents.) I washed the bejeezus out of that thing. It was old and required a lot of care, and as I logged hundreds of hours flying it, I learned a lot about what makes a rotary evaporator tick.

For starters, I learned what *doesn't* distill. Acids from lime juice, for instance, don't distill. Neither do sugars. In order to make my lime and gin distillations taste like lime juice, I had to add back lime acids. Lime juice contains a blend of citric and malic acids in a 2:1 ratio, with a pinch of succinic acid thrown in. This was my first clue as to why commercial tonic water wasn't as good as it could be: the makers use only citric acid. Citric acid on its own tastes only of lemon. It isn't till you add the malic acid (which, on its own, tastes like a green-apple Warhead candy) that the combination starts tasting like lime. Both citric and malic acid are easy to get, so it is criminal that the tonic makers don't add the malic. The real acid secret, however, was the tiny, tiny amount of succinic acid I added. On its own, succinic acid tastes terrible: bitter/salt/acid/unpleasant. Strangely, however, in minute amounts (a couple hundredths of a percent) it makes the flavor of the whole much better.

About this time I also began experimenting with distilling my own gin. I would add whatever flavors I liked—usually some combination of Thai basil, cilantro leaf, roasted oranges, and cucumber, with some juniper thrown in so I could call it gin. Some of those distillations were really good, but none of them were really gin. Learning to distill gave me a real respect for professional distillers. I decided to leave the gin to the pros.

My dad's gin of choice was Bombay. Not Bombay Sapphire, but old-school Bombay London dry gin, with the green label featuring Queen Victoria's sour mug. It is a fine product that I like better than the Sapphire. But when I make a G&T, I reach for Tanqueray. Here is my gin and tonic procedure, circa 2007:

Make a two-to-one mixture of citric and malic acid and dissolve the acid in water. Make some 1:1 simple syrup (I hadn't yet started making quinine simple). Make some diluted quinine water. Juice a bunch of limes. Add the lime juice to Tanqueray and distill it in a rotary evaporator at room temperature with a condenser chilled to at least –20°C (–4°F) so that 700 ml of liquid is distilled off for each liter of gin used. Get ice. Pour the gin into some ice and stir it down till cold and partially diluted (be careful not to overdilute at this stage). Add the citric-malic acid blend to taste, then simple syrup, then quinine water, then a pinch of salt and a pinch of succinic acid, then taste and adjust (I would go through four or five rounds of adding this or that till I thought it tasted right). Chill and carbonate (I didn't yet have liquid nitrogen, so I chilled the mix in the same chiller that I used to chill the condenser of my rotary evaporator).

THE BOTTLE-STRENGTH GIN AND TONIC

My distillation experiments with the G&T led to some bad ideas. The bottle-strength gin and tonic was an experiment in how far I could push the flavors of a gin and tonic. Could I make a gin-and-tonic shot that was at the same alcoholic strength as the gin that also tasted good? Of course I could. I had a rotary evaporator. I could easily pull some water out of the gin and replace it with tonic flavors, but there were issues.

For several reasons, I knew that a G&T shot would have to be served very cold. First, chilling blunts the impact of alcohol on the nose and tongue so other flavors won't be overpowered. Second, chilling increases the amount of CO_2 I could push into the booze at any given pressure, and highly alcoholic mixtures need a lot of CO_2 to taste really carbonated. I knew from tests with straight vodka that chilled shots taste best between –16°C (3°F) and –20°C (–4°F). Any temperature much below –20°C (–4°F) starts to be painful. I set my goals for the lowest guaranteed nonpainful temperature, –20°C (–4°F). Serving a shot that cold brings its own problems. The balance between sugar and acid is temperature-dependent. Your tongue's sensation of sugar is blunted by cold much more than its sensation of acid is. You need to add more sugar to a –20°C shot than one at –7°C (like one of my regular carbonated drinks) to get the same sweetness. Thus, bottle-strength gin and tonics are drinkable only in a very restricted temperature range. If you overchill one even a couple of degrees, you'll be cold-burning people's tongues. If you allow them to warm above –16°C, the shots start to taste sickly sweet and overly alcoholic. The bottle-strength gin and tonic was good *only* between –16°C (3°F) and –20°C (–4°F)—a mere 4°C of leeway! I knew I could serve the shots in perfect shape, but if the people I served it to did silly things like have a conversation instead of just drinking when I served them, the drink would warm up. I could see people standing around talking while the drink turned to crap in their hands, and it made me sweat. I realized that I couldn't force people to drink a shot immediately and in its entirety.

This experiment turned me off highly alcoholic carbonated drinks. I now serve carbonated cocktails with lower alcohol-by-volume content. They are more temperature-resilient, less cloying, and less stupefying, and I am better for it. The bottle-strength G&T is a stunt that I won't repeat again, but here's the technique if you're curious:

Mix a liter of Tanqueray with a half-liter of fresh lime juice and distill to 700 ml in a rotary evaporator at room temperature with a condenser set to at least –20°C. (Tanqueray starts off at 47.3% alcohol by volume here in the United States. Very little alcohol is left behind in the rotovap, so the 700 ml of distillate has an alcohol by volume of about 67%.) You now have a little less than 300 ml of room to add flavors to the redistilled Tank and still maintain a bottle strength of 47.3% alcohol by volume. Add concentrated lime acid and simple syrup, quinine, and salt to taste, then chill the mix down to –20°C (–4°F). Test for balance, adjust, then dilute back to 1 liter. Rechill the batch and carbonate at 50 psi. Store the carbonated G&T in a chiller at –20°C till it is ready to serve. Serve in very chilled shot glasses.

CLARIFICATION MAKES MY LIFE EASIER

Distilled lime essence doesn't keep any longer than fresh lime juice, so I always found myself slogging through a lot of distillation right before an event. This was a real hassle, because I could distill only about 1 liter per hour, during which time I was tied to the rotovap and couldn't do anything else.

When I finally figured out how to clarify lime juice, my life got a whole lot easier. I didn't have to use the rotovap to make a gin and tonic anymore! I could clarify *liters* of lime juice, and suddenly I could make huge volumes of gin and tonics for events. Life was good. The drinks were good. The only fly in the buttermilk: I was still chilling the drinks in large batches by hand, using liquid nitrogen prior to carbonation. This process made it difficult to serve the G&T in top condition at a *bar*, where chilling individual drinks with liquid nitrogen is problematic (see the Alternative Chilling section, here, for why). You can't stick the batch in a fridge—not cold enough—or in a freezer—too cold. To solve this problem I purchased a Randell FX fridge/freezer. It can maintain any temperature within a couple of degrees Fahrenheit. I just set it to –7°C (about 20°F) and let my carbonated drink batches chill for several hours prior to carbonation. Later the Randell keeps the drink in perfect condition for service.

If you are going to make your gin and tonics and drink them all in one day, go ahead and add the clarified lime juice before you carbonate. If you are going to keep your gin and tonics for more than a day (which makes sense for bar service), you should clarify fresh lime juice every day (never compromise on this) and add it to the precarbonated chilled drink at service time. The small amount of noncarbonated clarified lime juice doesn't mess with the carbonation. Here is my current recipe:

MAKES ONE 5½-OUNCE (165-ML) DRINK AT 15.4% ALCOHOL BY VOLUME, 4.9 G/100 ML SUGAR 0.41% ACID

INGREDIENTS

Full 1¾ ounces (53.5 ml) Tanqueray gin (47% alcohol by volume)

Short ½ ounce (12.5 ml) Quinine Simple Syrup (here) or Cinchona Syrup (here)

Short 3 ounces (87 ml) filtered water

1–2 drops saline solution or a pinch of salt

⅜ ounce (11.25 ml) clarified lime juice (6% acid)

PROCEDURE

Combine all the ingredients except the lime juice and chill between –5° and –10°C (14°–23°F). Carbonate at 42 psi. Add the lime juice

10°C (14°–23°F). Carbonate at 42 psi. Add the lime juice as the drink is poured into a chilled flute. If you carbonate with the lime juice, serve the drink that day. If you carbonate without the juice and add it later, your G&T will keep indefinitely.

So I don't leave you with a sense of incompleteness, here is a recipe for tonic water with options for the acidulant. The fresh lime juice option must be used fresh; the others will keep indefinitely but aren't quite as good. The procedure is the same either way. This tonic is on the dry side.

Tonic Water Two Ways

MAKES 34 OUNCES (1021 ML) AT 8.8 G/100 ML SUGAR, 0.75% ACID

INGREDIENTS

4¾ ounces (142.5 ml) Quinine Simple Syrup (here) or Cinchona Syrup (here)

4¼ ounces (127.5 ml) clarified lime juice (6% acid), or premade lime acid (here) (6% acid), or, if you don't have premade lime acid, 5.1 grams of citric acid and 2.6 grams malic acid and the tiniest pinch of succinic acid dissolved in 4 ounces (120 ml) of water (6% acid)

20 drops (1 ml) saline solution or a couple pinches of salt

25 ounces (750 ml) filtered water

PROCEDURE

Combine all the ingredients and chill and carbonate to between 40 and 45 psi.

FUTURE STEPS

Right now I'm interested in finding a drink that has the same feeling as a gin and tonic but contains no tonic, meaning no lime and no quinine. Why? I just want to. It is a challenge. I've come close. My two best candidates for tonic replacers thus far are schisandra berries and camu camu, a South American fruit. But, big drawback: the folks who sell them here in the United States think of them as medicines and superfoods, and they don't really care how they taste. That attitude drives me nuts.

SCHISANDRA

Schisandra berries (from the plant *Schisandra chinensis*) hail from China, where they are known as five-flavor berries. They are *almost* true to their name. They are tart and bitter (which is why they are good in tonic-style preparations) but a bit sweet and peppery as well. Four flavors. Supposedly they are also salty, but I don't really get that. I find the flavor intriguing.

Schisandra is used in China as a traditional medicinal herb. Here in the United States it is available as a dried berry of wildly varying quality. Avoid ones that are so desiccated as to resemble peppercorns. Look for ones that have a nice red color.

I have tried schisandra in water-based teas, directly steeped in gin, Justinoed into gin, and iSi-infused into gin. So far, direct infusion is winning out. Some of my tests have yielded very refreshing G&T-plus-pepper drinks that I like a lot. But I have not been able to get consistent results, probably owing to the variability of the product, so I have no recipe to share. I leave it to you to experiment!

CAMU CAMU

In 2012, I attended a lecture in Bogotá on the use of rare indigenous Colombian rainforest products. Typically I relish the opportunity to learn about any new ingredient. Unfortunately, the lecture was in Spanish and, stupidly, I can't speak Spanish. The speaker began the presentation with a fruit he claimed had more vitamin C than any on earth, an antioxidant powerhouse named camu camu (*Myrciaria dubia*). The fruit, I gathered from the little Spanish I could understand, contained 1.5 percent pure vitamin C. I could not have cared less. I get so much vitamin C on a daily basis that I make Linus Pauling look like he was about to get scurvy.

There was a tasting after the lecture. Out came some camu camu puree. I wasn't excited at first, since I had hoped to try fresh fruits. But apparently camu camu is harvested only by canoe-rowing collectors during the rainy season, from half-submerged wild plants. Fresh fruits would never survive the transport to the city and are converted to puree almost on the spot. The puree was bright red. I tasted it. Wow. I instantly knew I had found a perfect gin and tonic replacer! Imagine a fruit with the bitterness of tonic, the acidity of a lime, and an extra spiciness I can only describe as faintly Christmasy. I loved it. I pleaded, borrowed, and begged to get a single jar of the stuff. Because I was in Bogotá for a cocktail demonstration, I happened to have some Pectinex Ultra SP-L on hand, and a tiny $200 desktop centrifuge. I clarified the camu camu into a clear juice, mixed it with gin and sugar and salt, and carbonated it. Damn if that wasn't a fantastic drink. I was elated.

When I got home, I began researching camu camu. It *is* available in the United States, but mainly as a horrid powder. As I've said, superfood types don't tend to fret about taste. I finally found a source of the puree and ordered it. It was from Peru, not Colombia, but how different could it be? When it arrived, I anxiously shredded the package to get at it. When I saw the puree, I was crestfallen: it was yellow, not red, which meant one of three things: it was a different kind of fruit (or at least a different cultivar), it was harvested in an unripe state, or the skins had not remained in contact with the fruit pulp during processing. When I tasted it, my fears were confirmed. It didn't have the spiciness or the bitter bite. Damn. Someone out there in Colombia has access to this wonderful ingredient. Do the world a favor and use it!

SOURCES

EQUIPMENT AND BOOKS

Cocktail Kingdom
www.cocktailkingdom.com These folks sell all the good cocktail gear, and they have the best reprints of classic cocktail books that I have ever seen. Check out the Bad Ass Muddler, the fine-spring strainer, and the bitters bottle dasher tops.

J. B. Prince
www.jbprince.com
This is an awesome chef's supply store that sells only high-quality stuff. It has a wide array of ice carving/handling equipment. If you find yourself in New York City, visit the showroom at 36 East 31st Street, eleventh floor. You won't be disappointed.

Mark Powers and Company http://www.markpowers-and-company.com I get all my soda and carbonation supplies here except the carbonator caps, including cold plates, carbonators, Corny kegs, tubing, and clamps. The staff is friendly and the prices are good.

Liquid Bread
http://www.liquidbread.com Makers of the carbonator cap.

Katom
www.katom.com
This is a good inexpensive website for restaurant supplies like bar mats if you don't have access to real live kitchen-supply joints.

McMaster-Carr
www.mcmaster.com
Need some weird industrial doo-dad? Need it tomorrow? Are you willing to pay 30 percent more than you should just so you don't have to scour the Internet for another source? McMaster's got you covered. I use it constantly. Similar but less complete industrial suppliers are *www.grainger.com* and *www .mscdirect.com.*

Amazon
www.amazon.com
Yeah, you already knew to check here. I include it because many suppliers of scientific gear have started selling on Amazon, including purveyors of the $200 centrifuge and all the lab glassware you will ever need.

If you are looking for books, skip Amazon and buy from the folks at Kitchen Arts and Letters in New York, *www.kitchenartsandletters .com*. I support them. The knowledge they can offer up on individual books and authors is worth paying the extra nickels for.

For old books I used to use the aggregator *www.bookfinder.com* excusively, but it has become polluted with crappy reprints and I now rely on *www.ebay.com* and *www.abebooks.com*.

INGREDIENTS

Real Live Stores If you live in New York you have access to two great ingredient and spice shops that sell everything you need to make any type of bitters. Every major metropolis probably has similar shops. If you can't find them, the Internet is your friend.

Kalustyans, 123 Lexington Ave., New York, NY 10016
www.kalustyans.com

Dual Specialty Store, 91 First Ave., New York, NY 10003
The website is too horrid for me to direct you there.

Wherever you live (unless Manhattan is home) you probably have access to a home-brew shop that carries a lot of useful ingredients for cocktails, including malic, citric, tartaric, and lactic acid, as well as equipment like carbonator caps and other fun stuff. There are also scads of home-brew shops online.

INTERNET SOURCES

Modernist Pantry
www.modernistpantry.com A one-stop shop for modern ingredients such as Pectinex SP-L, hydrocolloids, and so on.

Terra Spice
www.terraspice.com
A good place for quality spices and extracts.

WillPowder
www.willpowder.net
Supplies modern ingredients from pastry chef Will Goldfarb.

Le Sanctuaire
www.le-sanctuaire.com
A supplier of high-end cooking equipment and ingredients. This site has the best selection of hydrocolloids from CP Kelco, the folks who do gellan and really good pectins.

TIC Gums
www.ticgums.com
The folks who make Ticaloid 210S and Ticaloid 310S, the mixture of gum arabic and xanthan gum that I use to make orgeats and oil syrups. They will sell to normal folks like us.

ACKNOWLEDGMENTS

Thanks to my wife, Jennifer, who spent an inordinate amount of time beating my rambling, incoherent first drafts into the language we call English, then revising and polishing the finished book. I have loved her clarity of thought and distaste for nonsense since we first met. Without her I could not write any sort of book anyone would want to read.

Thanks to my editor at W. W. Norton, Maria Guarnaschelli, who invited me to lunch one day three years ago and decided I was going to write a book. I often hear from author friends that old-school editors don't exist. I now know that they are wrong. I am extremely fortunate to have had such a passionate, involved, and caring advocate to shepherd this book into existence.

Thanks to:

Nastassia Lopez, for keeping the wheels on the bus.

My partners, the inimitable David Chang and Drew Salmon, for believing in Booker and Dax and in me. I am forever grateful.

Travis Huggett, for such a fine job on the photography.

Mitchell Kohles, for doing a lot of heavy lifting at W. W. Norton.

Harold McGee, for the constant inspiration and for his thoughtful review of drafts of this book.

James Carpenter, for going through the manuscript with his laser eye for detail.

John McGee, Paul Adams, Ariel Johnson, and Don Lee for their input.

And thanks to the people who have inspired me and supported me on my decidedly non-linear career path, even when my endeavors seemed far-fetched: My mom and Gerard, my dad, and the whole Addonizio/Arnold clan; Maile, Ridge, and the rest of the Carpenters.

Early, Ludwick, Sweeney, and Strauss, who helped foot the bill.

Jeffrey Steingarten and Dana Cowin, early supporters who helped me find my place in the food world.

Michael Batterberry, who got me my first real job in the business.
Wylie Dufresne, who started me on the road to using new technologies in the kitchen.
Nils Noren, with whom I’ve done some of my best work—Skoal!
Johnny Iuzzini, from whom I learned a lot when we were knocking around together.
The chefs I worked with at the FCI, and the students in my FCI intern program (with a special shout-out to Mindy Nguyen.) The talented crew I’ve worked with at Booker and Dax: Piper Kristensen, Tristan Willey, Robby Nelson, Maura McGuigan, and all the bartenders, bar-backs, servers and hosts—you too Ssam crew!

Finally, thank you to all my friends in the cocktail community—you motivate me every day.

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