COFFEE FOR THE MILDLY OBSESSED

THE BARISTA MANUAL

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Figure 7.2 Tea Processing is based on Tony Gebely's Tea Processing Chart

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Introduction

How to Use This Book

This is a fixed-form multi-media reference manual; as such you cannot change the text size and it is best viewed in landscape on a computer or tablet. As in a traditional manual there are blocks of text with diagrams and images throughout. These are supported by video. That's all very good and modern, but to keep the weight down, the video and some larger images are stored online.

Expandable pictures

Some pictures are too small to read properly in this format. These pictures have larger versions on the web. You can access these versions by simply clicking the picture. Tap the picture in Figure Introduction.1 for an example.

Videos

Videos are all stored on the web. Tap the poster image of the video to open a link to the video online.

Figure Introduction.1
Example of an expandable picture – Harvest seasons

Pictures that are too small to be seen properly on the page are stored on the web and are hyperlinked. Tapping on the image should open your browser and take you to a larger version of the image.

Quizzes and reviews

There are reviews at the end of each section. These questions test your understanding of the key concepts in the topic. The answers follow on the page after the questions. These tests are an essential part of the learning process. Use them to see how well you've absorbed the information and if you find an answer confusing, go back and read up on that subject again. The questions are arranged in the order that the explanatory content appears in each chapter.

Table of contents

You can access the table of contents from the top menu within this book. Each platform has a slightly different location for the table of contents.

Glossary

There is a glossary at the end of this book with words that are peculiar to speciality coffee. The first time that a glossary word appears in the text it is bold like **this** and is linked to its glossary entry.

What’s in This Book?

Many people who don’t know much about making coffee think it’s all just a matter of pouring the right amount of boiling water over the right amount of coffee grounds. But what might be thought of as a simple process is in fact reliant on a large number of variables; that’s all thanks to the physical complexity of the human body’s flavour perceptions.

Go to your local supermarket, stand in one of the aisles and look at all the ingredients around you. If I asked you to make a meal out of a combination of any of the items that you can see, you’d probably be able to pull out ingredients that you already know have complementary flavours, textures and (for extra points) a bit of colour. Too easy a task! When we extract flavours out of coffee, we can’t see the individual flavours that we’d like to pull out.

Making a truly great coffee is like asking someone to make a meal from a thousand supermarket items. With a countdown timer. Blindfolded. Using a firehose.

This book helps you on the road to making excellent coffee by looking in detail at the various components that contribute to memorable brews. Each chapter starts with a piece relative to the topic to ground it in reality. We then move from a broad overview of the topic to focus more closely, examining each of the variables that affect the flavour of coffee.

Chapter 1: Coffee We begin by looking at speciality coffees and how their origins, handling and roasting differ from commodity coffee. If you’re reading this, you likely already know how frustratingly tricky coffee making can be — Chapter 1 looks at the brewing methods that make the complexity of coffee easier to handle. Reading this chapter will make brewing decent coffee as easy as drinking it, and will help you on your way to making excellent coffee through a study of variables for manipulating the best brew possible.

Chapter 2: Water Curiously, information on water is often missing from books on coffee. But omitting water from a book on coffee is like omitting flour from a book on bread. Water is the solvent that extracts our coffee and its makeup has an intense effect on the flavour of our brew.

Chapter 3: Grinding Grinding is how we access the flavour and where most of the problems with preparation occur. In this section, we jump inside the coffee beans to find out where all the lovely flavours hide, examine the limitations of grinding brittle beans, and sieve out the bits to avoid.

Chapter 4: How to Drink Coffee Without the ability to taste, all the rest is pointless. Here, we look at flavour perception and how the industry approaches it so that we can do our job of making great coffees. Brewing coffee is an experiment in itself. Drinking it gives us feedback on how to brew it better for next time. The ability to make and taste great coffee (and ironic coffee tats) are what sets baristas apart from super-automatic bean-to-cup machines. The better our ability to perceive flavour is, the better baristas we become.

Chapter 5: Espresso It's pressure that intensifies the whole process of espresso making. It's also the 'moneyshot', so to speak, so it gets its own rightful chapter. Here, we look at the basics of espresso preparation and then reexamine the variables that we can use to manipulate the flavours from coffee under pressure.

Chapter 6: Milk Milk is an ingredient in most of the coffees we serve to customers. Here, we look at what you need to know to make coffee tastefully milky.

Chapter 7: Teas & Chocolate Most cafes also offer tea and hot chocolate, but they're usually tacked on as an afterthought. It's a mistake: when it's high grade and well made, tea can rival even coffee for flavour and richness. In this chapter, we'll look at two methods of serving tea that are fit for a Dai-oshō monk. Tisane is the term for all the other brews that people drank long before coffee was a glint in the eye of an Ethiopian goat-botherer. We look at two tisanes that are drunk by millions and are likely to be “coming soon to your nearest coffeeshop”, even though you mightn’t have heard of them. And we’ll look at chocolate – the latest swelling wave in the cafe industry – in the final section of this chapter we’ll examine what chocolate once was and what it will become.

The goal of the book is to get you to understand the essential concepts involved in getting the best possible flavours out of these drinks, and for you to be able to communicate them to fellow baristas, customers – and hey, even glassy eyed dinner-party guests who were sure they’d left their canapés at the other end of the room...

All in all, this book promises to get you enthusiastic about the sensations of coffee and for you to be able to convey that enthusiasm to its adoring fans. Baristas work in the service industry, so it’s essential to understand and be able to interpret these sometimes complex concepts at an appropriate level for customers. To reinforce certain points, there are videos and exercises, as well as self-assessment quizzes at the end of each section for you to see if you need to revise anything important.

Reading this book cover to cover means you should be more than capable of *making* great coffee, and *explaining* the complexities involved in extracting its best flavours using different preparation methods. Importantly, you’ll also become more aware of (and actively using) your senses of taste, smell and touch to actively experiment with and improve your coffee.

Happy learning, great coffee, happy customers!

Michael xxx

Who's It For?

This book is for baristas and cafe owners who focus on coffee-making, and for coffee trainers who need practicable models for explaining key concepts.

When I was starting out in the world of coffee, there was a lack of good information about the practice. The only places to get useful information were online forums like Coffeesnobs, Coffee Geek and Toomuchcoffee – all of which remain excellent sources of information – and David Schomer's book *Espresso Coffee: Professional Techniques*, which was revelatory for its time, but quite outdated today.

Today, the problem is that there is far *too much* information, and much of it conflicting. This book's research was mostly gathered from the sources listed in the Further Reading section and refracted through my own experiences of an education in genetics, setting up cafes and roasteries, and training staff. I'm also surrounded by a lot of very inquisitive people who are always experimenting with coffee.

Coffee for the Mildly Obsessed is for readers who are eager to learn about quality coffee but are overwhelmed or confused by the wealth of information out there. Practical skills are really best learned on the job or through workshops but this manual is an essential reference (supplementary or not) and is here to help you learn at your own pace.

I feel that each cafe owner has his or her own philosophy and way of doing things, so you won't see any sections on customer service, retail and work culture in this book. However, the one thing that I will say on these topics is: if you don't like people, then you're probably in the wrong job. The good news for the misanthropes is that the coffee industry is still vast and there's probably a secluded job for you somewhere within – it may just take a little longer to find it.

The barista's job

Your job as a barista is to consistently get excellent tasting coffee to the customers' lips. The essential tools for achieving this are your senses of taste and smell. To be able to do your job properly, you have to get into the habit of taste-testing coffee. While a solid understanding of coffee-making theory will certainly help you to achieve the best results, developing your ability to truly *perceive* coffee really is the most important skill for becoming excellent at your job of coffee preparation.

The focus in this book is on 'sixth stage' coffee, that is, the stage in the coffee-making process where the grower, roaster and barista all communicate to get better-tasting coffee.

And that brings us to our first chapter...

CHAPTER 1

Coffee

Not all coffees are created equal. Let's find out why most beans are inferior and how to coax the aromatic wonders out of good beans.

Speciality Coffee

The world’s best coffee on a ferry

Great restaurants rarely serve great coffee, and even the best restaurants are guilty of using poor quality commodity coffee. But some are now waking up to the fact that coffee can no longer be paid lip service – it’s a part of the overall dining experience. Noma in Copenhagen, considered one of the finest restaurants in the world, pays serious attention to every last detail of their restaurant, food and service. Yet until 2013, Noma served the kind of coffee that the enlightened barista might justifiably call 'grim'.

Coffee service at Noma

Photo by Tim Wendelboe

When René Redzepi, chef and owner of Noma, decided to pay the same attention to coffee as he paid to everything else gastronomical, the process took four years to get right. Several ripped up floorboards and an eight-month training programme later (under the guidance of Tim Wendelboe, author of 'Coffee with Tim Wendelboe' and owner of the eponymous roastery in Oslo, Norway), their goal of serving the best restaurant coffee in the world was finally reached. The coffee they now serve is undoubtedly excellent.

Yet when he started, Redzepi had no idea that simply making great coffee would be such a difficult goal to attain, or that people would be so resistant to what they were trying to do.

The customer response to this change was mixed. Reporting on the reception of Noma's improved coffee service in his talk "Milk and Sugar, Please!" at the Nordic Barista Cup in 2013, Redzepi said that one critic who had otherwise enjoyed his meal at Noma sneeringly likened his after-dinner coffee to the sort he would normally expect on his daily ferry commute. Many of the customers, it seemed, had preconceived ideas about how coffee should taste.

While they were prepared to be challenged with their food, even with their wine, the sentiment most often expressed concerning Noma's coffee was: "don't fuck with it". Noma, however, continued to serve what they considered to be the best, and its customers gradually came around to the idea that coffee can have delicate fruity flavours. They had challenged their customers' preconceptions of coffee flavour – and it seems that they had succeeded.

Coffee in the popular imagination

Most people's concept of what coffee *should* taste like is completely different to the style of coffee that we're discussing in this book. The flavour that you had as a kid in coffee-flavoured lollies is definitely *not* what we're after. Most coffee discussed in books or in research papers are 'fourth stage' (we will get to this later), and much information on the Internet is industry sponsored or pertains to 'fifth stage' coffee – commodity coffee – with many defects (see Figure 1.1), at higher roast levels.

This gap in information is changing and there is a lot of great content now available online, but it's still difficult, even for the long-in-the-coffee-stained-tooth professionals, to distinguish between the iron pyrite of pseudoscience and the flash of real instructive gold.

Figure 1.1 Defect beans

Both pictures are of the same bean. The left picture is the highest grade, which is sold as speciality coffee and the right picture is the worst grade of commodity coffee. All beans are 100% arabica.

The six stages of coffee

People first brewed coffee leaves in the same way as they brewed tea. This process can be called **Stage 0 – Brewed as a tea**.

The first 'real' stage came about when some bright spark decided to roast the beans. Thus began **Stage 1 – Roasting the beans**.

During the Industrial Revolution, labourers started working to the clock instead of to the sun. There followed an increased demand for coffee to keep workers alert and Jabez Burns, a man with great entrepreneurial drive and an even greater back shed, invented the continuous industrial roaster. This was **Stage 2 – Industrial roasting**.

A man by the name of George Washington (no, not *that* George Washington) invented instant coffee. This led to **Stage 3 – Instant coffee and cheap prices** for consumers... leading to a cheap prices and depression for farmers.

In the 1970s, companies like Peets and Illy started to buy better grades of coffee than was common in coffee-consuming countries. And so began **Stage 4 – Better grades of coffee**.

In the 1990s, companies like Coffee Supreme in New Zealand and Five Senses in Australia started roasting and suppling fresh coffee to cafes. This was a marked improvement on the stale beans used in Stage 4. This became the era of the glorious **Stage 5 – Fresh roasted beans**.

The sixth stage of coffee has only been possible since roasters have been able to get their hands on great green beans. It's only recently that growers have been able to get prices for their high grade, quality coffee that is high enough to justify the extra effort required to produce it. **Stage 6 – Beans, roasting, preparation** is characterised by single origin speciality coffee where the grower, roaster and barista all communicate to achieve the best possible flavour from the coffee.

Sixth-stage coffee is where the barista, roaster and grower all work together to create the best flavours possible.

The coffee trinity

Sixth-stage coffee is produced by a trinity of the green beans (1), the roasting (2) and the preparation (3).

Green beans (1)

Varietals

Coffee comes from the genus *Coffea*. Within this genus, there are 128 species. The species that we use to brew speciality coffee is called *arabica*. Within this species are hundreds of varietals. Varietal classification is as arbitrary as the difference between an Asian or European human being (see Table 1.1). However, different varietals can have very different flavour and tactile qualities.

Most farmers choose varietals that have a high yield rather than a necessarily great taste. They've got some land, and they want to make money from it. However, given the higher price needed for speciality coffee (or out of sheer pride in their product), some growers will still choose to experiment with different varietals to produce better tasting coffee.

As is also the case with people, the (flavour) characteristics of coffee beans are the product of nature and nurture. Varietals are the natural result of this – everything done before the beans are roasted can be thought of as their nurture.

Table 1.1 Comparison of taxonomic terms

	Coffee	Human
Genus	Coffea	Homo
Species	arabica	sapiens
Varietal	SL28	Aussie

Terroir

Terroir is used to describe all the environmental conditions that affect the flavour of green beans: soil composition, atmosphere, the side of the mountain, rainfall, altitude, etc. Any number and any combination of these things may introduce qualities that change the flavour and/or texture of the coffee.

Single origin

To have a particular terroir, process (we look at this in more detail later) or varietal, coffee needs to be gathered from a single source. This is known as single origin (SO) coffee. SO comes from estates or small cooperatives.

Most coffees are sold according to grades or sizes and are an aggregate of beans from growers across regions or even entire countries. Such beans are generic and have few of the qualities that we seek in speciality coffee.

SO coffee means that the grower can directly influence a coffee's flavour through repeated experimentation with the way he or she grows the coffee beans. Michael Gehrkin, owner of Blackburn Estate, Tanzania, has put out the **microlots** Clouds of September (2009) and Clouds of August (2010), where cherries were *only* picked in the morning, while the mists were still hanging about the estate. In 2013, Blackburn Estate released three coffees grown in different areas of their estate. (1) 'Shade', grown under trees. (2) 'Sun', grown directly exposed to the sun. (3) 'Tembo', grown along a corridor on the estate that allowed wild animals to cross. These microlots had a similar flavour to other coffees on his estate – but with distinctive differences. 'Sun' was lighter with great aftertaste and notes of gooseberry and kiwifruit, 'Shade' had a good body and good aftertaste with notes of papaya and orange, and 'Tembo' was lighter with reduced aftertaste and notes of grape and lemon. By separating the growing areas on his estate, Gehrkin was able to experiment with the conditions for growing and processing his coffee. That's a perfect example of single origin and why it's important for those of us brewing coffee.

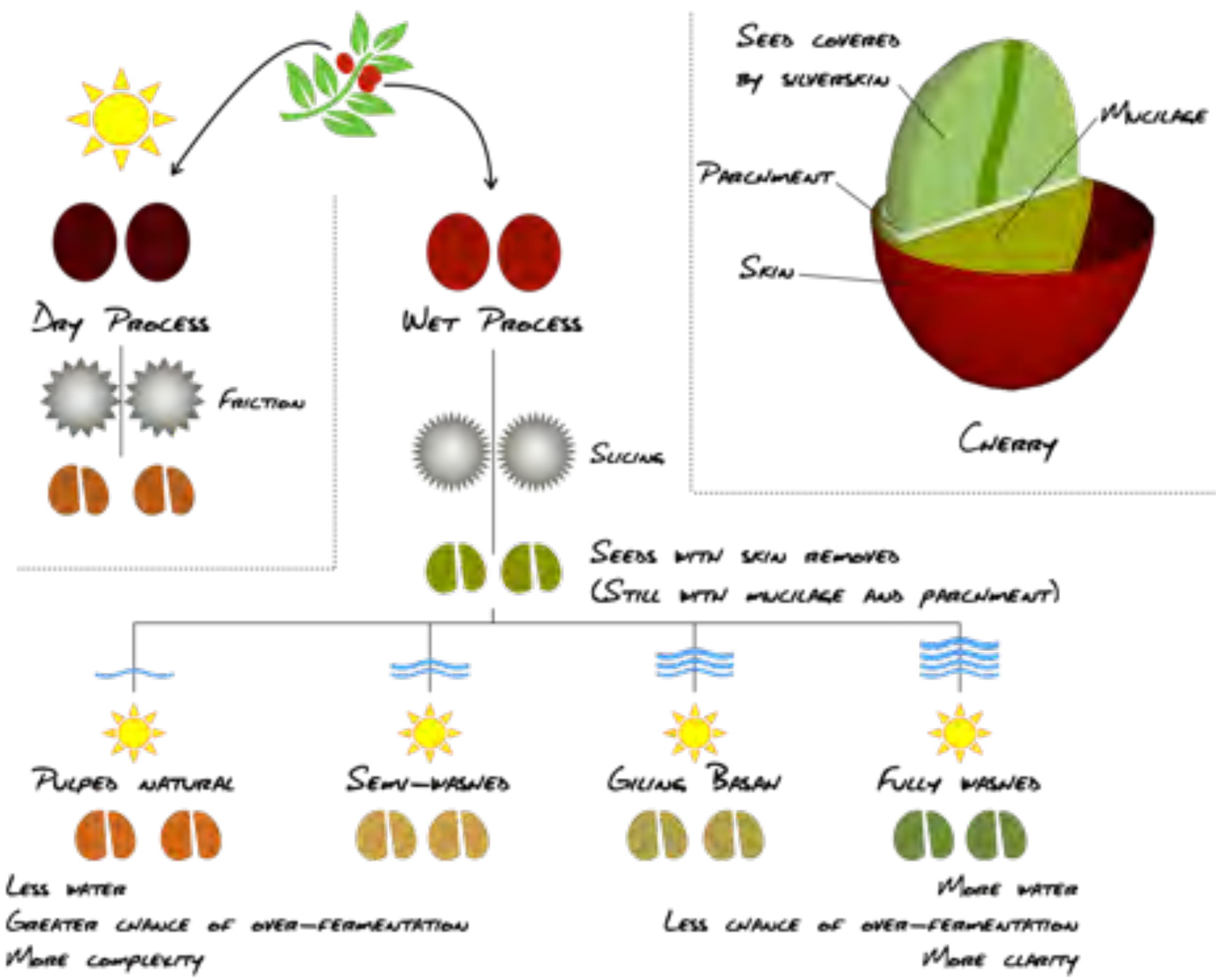
Processing

The aim of processing is to go from moist coffee cherries, each encasing two seeds, to becoming dried seeds (which we call beans), all the while avoiding uncontrolled fermentation. Typically, coffee is either processed without water (dry, natural) or with water (wet, washed). The main categories of wet-processed coffee are: pulped natural, semi-washed, giling basah, and fully washed. Figure 1.2 gives an overview of how most coffee is processed, however there are many more ways of processing green beans than there are countries that produce it. The method of processing has a marked effect on the flavour of the coffee. Typically, the longer the fruit stays on the bean, the more 'complex' – some would say 'uneven' – the flavour will be.

Packaging and storage

Traditionally, coffee was packaged in burlap or jute bags and much of it (including some great coffee) still is. As romantic as this packaging is, it leaves the coffee vulnerable to changes in moisture as the beans travel from tropical climates through temperate zones, and then either dry or soften when they arrive in temperate or tropical zones. Shipping containers should have silica moisture absorbers inside, but many don't. To prevent damage to the beans in transit and while stored, quality beans should be packed in GrainPro bags or be vacuum-packed. Coffee kept in humid countries should be stored in climate-controlled storerooms.

Figure 1.2 Processing overview



Roasted coffee should be packaged in bags that provide an adequate barrier against air and moisture and be vacuum-sealed. The beans need to be packed immediately after roasting.

Coffee beverage quality is made up of three things: raw product, education and equipment. Of the three, the most important is the raw product: the green beans. Every year brings in new methods, gadgets and trends for brewing coffee, but the greatest factor to ensuring an increase in quality for coffee is the price differentiation between speciality coffee on one hand, and commodity and **certification coffee** on the other.

Speciality grade

The Speciality Coffee Association of Europe humbly offered up a call-to-arms with this definition of speciality coffee in 2014:

> *Speciality coffee is [...] a crafted quality coffee-based beverage, which is judged by the consumer (in a limited marketplace at a given time) to have a unique quality, a distinct taste and personality different from, and superior to, the common coffee beverages offered. The beverage is based on beans that have been grown in an accurately defined area, and which meet the highest standards for green coffee and for its roasting, storage and brewing.*

It's an overly complicated way of saying "Great tasting, single origin coffee" but they obviously felt the need to define 'speciality' in opposition to 'commodity'.

To get those distinct tastes and delicious aromas into the cup, each person in the coffee chain is in some way responsible for preserving its quality. With each step in getting coffee from the plant and into the cup, there is the potential to degrade the beans' quality. It's not enough for the beans to have come from a famous coffee estate. If speciality greens get wet during transportation, or the roaster does a poor job of roasting them, or the roasted beans are stored for months on end before they eventually reach the cafe, or the barista underextracts the grinds, then those great beans have passed on, they have ceased to be, expired, are no-more, bereft of life... it is *ex*-speciality coffee!

Speciality grade beans are a good beginning, but speciality green coffee isn’t speciality coffee until it has been roasted and prepared and still manages to switch on the **olfactory bulb** (we’ll get to this later) of the customer drinking it.

Identifying speciality coffee

Some of the old fifth-stage roasters stepped up and became sixth-stage roasteries, but most didn't. Most of the coffee touted as speciality on the market is nowhere near as good as the marketing material claims it to be. When coffee quality is the product of green beans, roasting and preparation, how can we be sure that it's not our driech preparation that's preventing the sun from shining out of our coffee cup? Assuming that the coffee has been stored properly, there are two ways: cupping, which we shall deal with in Section 2 of Chapter 4, or by chewing on a bean.

Before you put that bean into your mouth; if it's oily on the surface, it's not what we're looking for here. Some people like coffee this way, and that's fine, but oil on the surface is indicative of aggressive roasting that would burn the delicate flavours that we crave in speciality coffee (see Enzymatic aromas).

Take a coffee bean and chew it. If the bean is too hard and feels like you're chewing a small coffee pebble, the coffee was likely under-developed in the roast. If the bean is too powdery and tastes ashy, then it's likely that it has been over-roasted. If it has some level of acidity and you get some nice flavours when you breathe out through your nose, then you may have beans that have the potential to make a decent cup of coffee.

Don't rely on just one bean as your sample. There's always a chance that you grabbed the one corpse out of a bag of vitality. Try a few to make sure. If there's no life in the beans, then it's pointless trying the exercises in this book. Go out and grab another bag, perhaps from another roaster.

Roasting (2)

The resulting flavour that we get after roasting coffee is dependent on a combination of equipment, methodology and packaging.

Equipment

Equipment for roasting ranges from a simple wok and a stick to huge continuous roasters where whole shipping containers are upended and 20 tonnes of coffee beans are roasted at a time. In speciality coffee, most types of roasting machines are either drum or air roasters of 60 kg capacity or less. The critical thing is for the machine to be able to change the rate of heat application to the bean pile at any time and to be able to do this consistently from one roast to another.

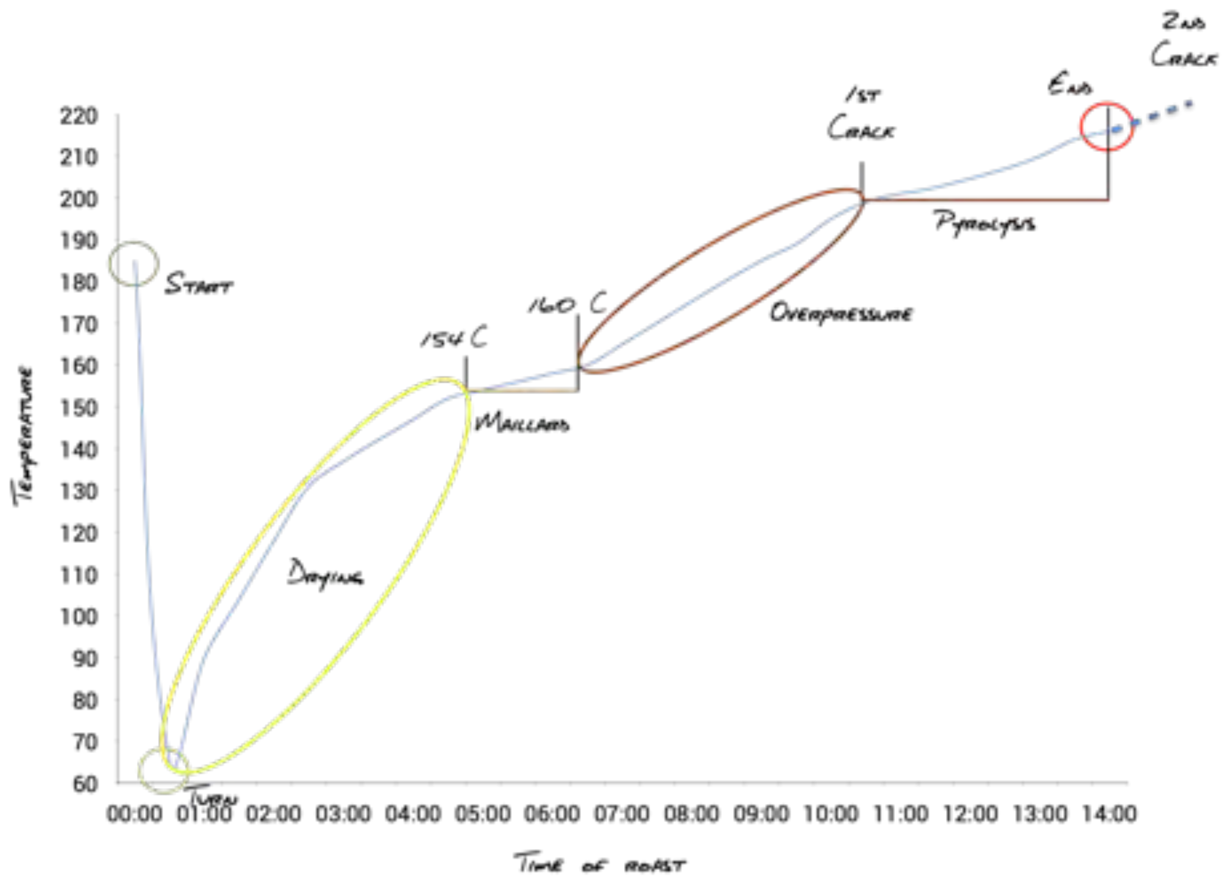
The Loring Merlin coffee roasting machine.

Methodology

Different roaster operators have different ideas of how to roast and what variables to play with. These range from the blindly prophetic “the beans tell me what to roast” to the methodical “test and adjust”. Here’s what I know: methodical roasting works. Using a methodical approach and a number of test batches, it’s possible to roast the coffee to adjust its acidity, sweetness and bitterness, enhance the aromas preserved within the beans, and play with mouthfeel, body and aftertaste.

Good coffee roasters use the same methodology that good baristas use when dialling in the grinder. When we receive a new type of bean we ‘best guess’ a roast based on the bean’s size, the varietal and the altitude at which it was grown. Like a chef altering the roasting time for a piece of meat depending on its cut and weight, we also use a different variable for each of the beans’ variables. This is called ‘profile roasting’. Once we’ve roasted the beans, we try them, just as a barista does after pulling an espresso shot – the difference is that it takes the roaster days, rather than minutes, between roasting and tasting. Good coffee roasters think about the flavours that they get from the beans and what they'd like to accentuate or remove, then they change the most likely variable to bring this result about and roast some more.

Figure 1.3 Roasting by profile



Once they have developed a profile for a bean (see Figure 1.3), they roast in exactly the same way to ensure consistency. They will have to adjust the profile depending on the weather and continue tasting the coffee after each roast because the profile will need to change as the beans age, but, in the main if they stick close to the original profile, they'll to get similar tasting beans.

As roasters come to use better beans, they tend to roast lighter to highlight their origin flavours. These light roasts can be great, but they need proper development to avoid tasting green and vegetal. Well-roasted beans are essential for your job as a barista. If the beans come from the roastery with repeated roast defects, let the roaster know. If they can't fix it, it might be time to seek out a new roaster.

Packaging

After the beans have come out of the roaster, they need to be cooled and packed as soon as possible. Packaging ranges from paper bags, through triple-layered laminar plastics to tins or jars. Packaging is the container that helps us transport units of coffee, but it also needs to preserve the coffee. Barrier bags that can be vacuum packed and sealed to protect the coffee from oxygen is the best option currently available.

Preparation (3)

Preparation is the last domino that we need to fall. Get this one wrong, and all the other factors lined up for achieving great coffee will have toppled for naught. The best way to get the most out of the coffee we've been given is by using the same method of testing and adjusting – as speciality growers and roasters do. We brew coffee using a 'best guess' recipe, and test it by tasting it. We then manipulate the preparation to get the best flavours according to our own taste. This is a simple scientific method: changing one variable at a time before repeating a test in order to discover a better solution.

The rest of this chapter deals with the third part of the trinity; the preparation. Before we start playing with variables, we're going to have a look at what goes on 'behind the scenes' when we brew a cup of coffee.

1.1 Key learning points

1. Most coffee served in even the best restaurants is poor quality commodity coffee.
2. A lot of information on the Internet is about commodity coffee. Handle with care: it is often sponsored by the industry and is therefore biased.
3. The sixth-stage of coffee is all about the grower, roaster and barista working together in the pursuit of achieving exciting flavours.
4. Single origin coffee comes from an individual grower or a small cooperative. It is not generic country coffee.
5. Coffee beverage quality is made up of three things: raw product, education and equipment.
6. Speciality coffee is high grade, single origin coffee with pleasant flavour characteristics.
7. We need to use scientific methodology to attain, improve and retain the best flavours from the coffee beans.

Review of Speciality Coffee

Question 1

Which of the following options is a difference between fifth and sixth stage coffee?

A. Expiry date vs. roasted-on date
B. Traded through London vs. New York
C. Generic vs. single origin coffee
D. Cappuccino vs. flat white

Question 2

What do we mean by "sixth stage coffee"?

A. The barista, roaster and grower work together to get the best flavours
B. The customer comes first
C. The finest grades of coffee in the world
D. The best coffee, roasted in the best way and prepared by the best baristas

Question 3

What are the two best methods of packing speciality green coffee?

A. Grainpro bags
A. Jute Sacks
B. Loose containers
C. Vacuum packed

Question 4

What is the best method for packaging roasted coffee?

A. Heat-sealed with a zipper bag
B. Vacuum packing
C. Tri-laminate barrier protection bags
D. Kraft paper bags

Question 5

"Most coffees are sold according to grades or sizes and are an aggregate of beans from growers across regions or even entire countries." Choose the answers that describe these beans.

A. Generic
B. Commodity
C. Speciality
D. Single origin

Question 6

What are the main categories of wet processed coffee?

A. Pulped natural
B. Natural
C. Dry
D. Semi-washed
E. Giling basah
F. Fully washed

Question 7

What is the best method for roasting coffee?

A. Sight evaluation
B. Scent evaluation
C. Profile evaluation
D. Temperature evaluation
E. Accurate measurement through methodical testing and adjustment

Review 1.1 Answers

Question 1

Correct answer: C

Question 2

Correct answer: A

Question 3

Correct answer: A & D

Question 4

Correct answer: B

Question 5

Correct answer: A & B

Question 6

Correct answer: A, D, E & F

Question 7

Correct answer: E

Thinking About the Brew

Photo by Astra Plepe

Brewing coffee

Nespresso capsules contain 4 g of questionable grade coffee, and yet many of the world's best restaurants, including the three Michelin-starred restaurant The Fat Duck in England (at time of writing), choose to use Nespresso machines... because pushing a button is much easier, and more consistent, than is brewing good coffee.

When Noma introduced speciality coffee to their drinks offer it took coffee trainer, Tim Wendelboe, eight months of training to get the staff up to the standard required for serving coffee in a two Michelin-starred restaurant. According to René Redzepi, an unexpected side-effect of this introduction was that the waiters suddenly felt much more motivated at work. They had ceased to be merely *waiting* and had, in effect, become *creators* of coffee. Through skill and understanding they were able to create delicious flavours using one of the most complex foodstuffs.

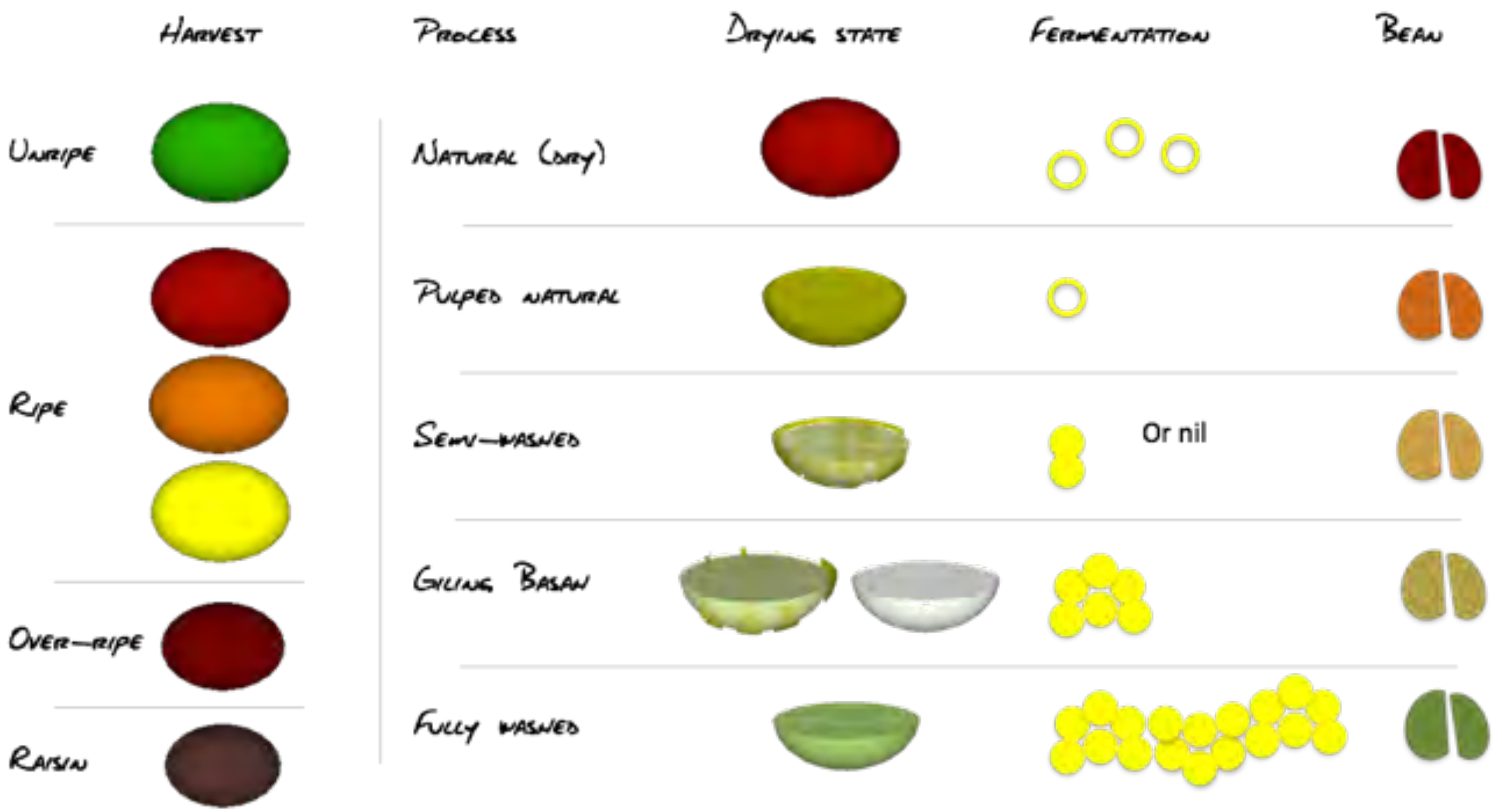
On a fundamental level, brewing coffee is simple: take coffee, add water. Yet brewing is difficult enough to make The Fat Duck decide in favour of plastic coffee pods. Coffee contains many different flavour compounds. Some of them are flavoursome, others are downright unpleasant. Our goal is to coax the delicious out and throw the disgusting away in order to produce a brew that tastes great. Coffee and water are our essential ingredients. The rest is down to taste and an understanding of how the variables change it.

Photo by Tim Wendleboe

Understanding the beans

I highly encourage you to read up on the processing of coffee and to physically get yourself to origin to see it grown first hand. For now, though, I'd like you to simply associate the process that the beans have been through with the kind of flavours that you get as a result. An overview of the affect of processing is in Figure 1.4. Once you start to gain an understanding of how processing affects the flavour of the coffee – and how you should prepare it accordingly – your brewing will improve.

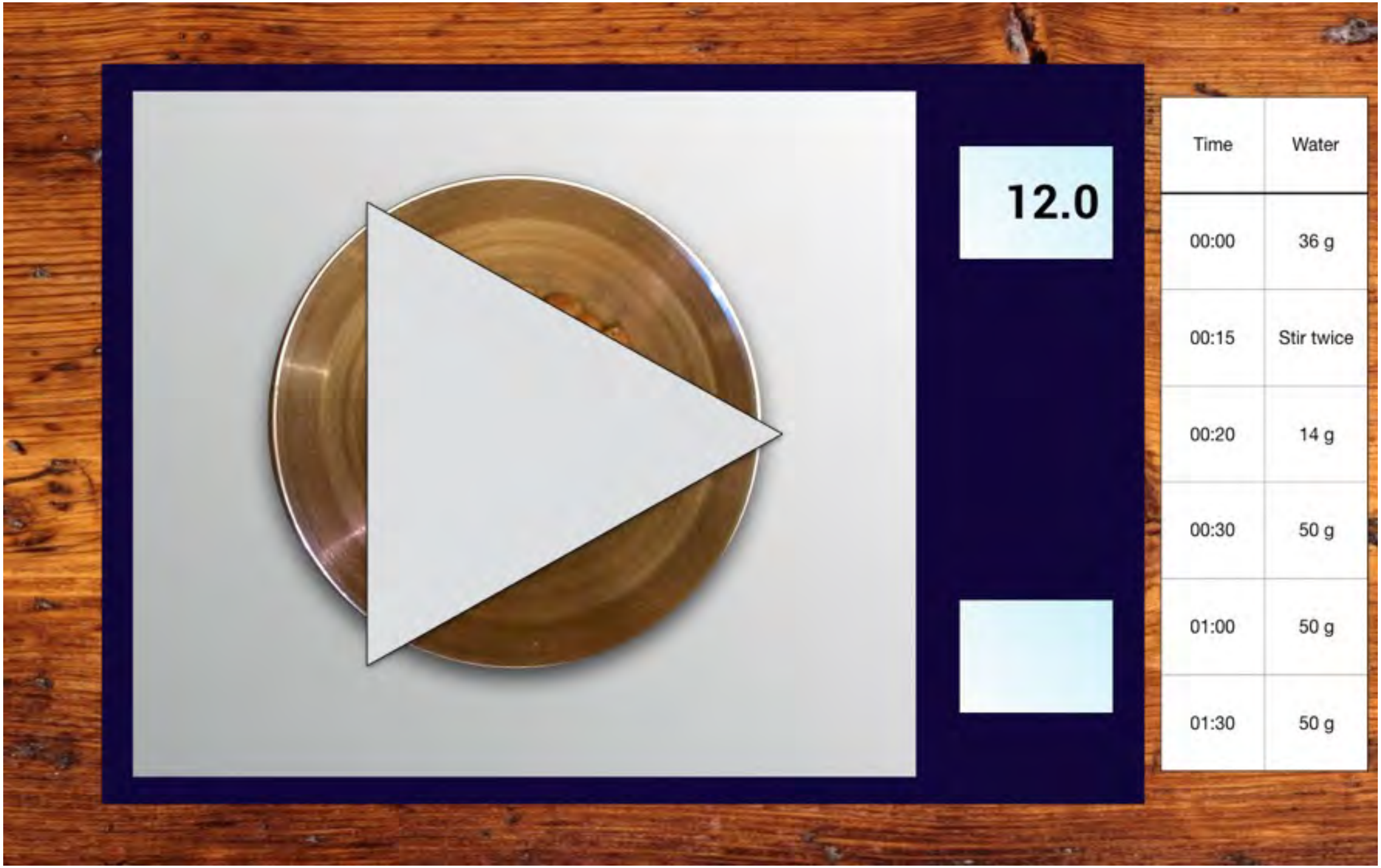
Figure 1.4 Graphical representation of harvest states and affect of processing



Depending on the care and grade of the coffee, the cherries are harvested in varying states of ripeness – the riper the cherry, the sweeter the bean. The processing further changes the flavour through varying contact with the fruit and differing levels of controlled and uncontrolled fermentation.

For a broad overview of the brewing process, Video 1.1 gives an example preparation method using the v60 coffee brewer:

Video 1.1 v60 recipe



v60 exercise

Tools

12 g coffee beans

v60 coffee brewer

v60 filter paper

Water

Method

1. Weigh out 12 g of coffee beans.

2. Wash out the filter paper and warm the v60 cone thoroughly with hot water.

3. Grind the coffee finely (exactly which grind is dependent on previous tests. The burrs on the disks shear the beans into particle sizes of a narrow range. Each particle comprises many intact cells as well as ruptured cells). Much of the oil that contains the flavoursome aromas will now be exposed.

4. Reweigh the grinds to check that you haven't lost any in the grinder. Place the v60 brewer on the scales. Add your ground coffee. Zero the scales and start your timer.

5. Take water that has just boiled and quickly pour 36 g of water into the bed, taking care to wet all of the coffee. The temperature of the water cools as it falls and will hit the coffee at around 91-94ºC (196-201ºF). The hot water displaces the air around the coffee grinds and CO_2 gas inside the bean cells rapidly expands as it heats up and escapes through the semi-permeable membranes of the cell walls. This then bubbles through the slurry causing turbulence and hoists some of the grinds out of the water and on top of the bloom.

6. To make sure that all of the grounds are wet, stir the bed like a Kama Sutra expert, then top up with water to take the scales to 50 g.
7. After 30 seconds, pour in another 50 g of water, starting in the centre of the cone and working your way outwards in a spiral. Take care to wash down any grounds that have become stranded on the sides. The temperature of the coffee slurry is likely to drop down to 70ºC (158ºF).
8. After 1 minute has passed, add another 50 g water.
9. At 1 minute 30 seconds, add another 50 g water. Wait until the last drop of water has fallen before removing the cone.
10. In the cone are the spent coffee grounds, along with around 22 g of water. In the cup are the coffee solids suspended in around 178 g of water.

We'll discuss what just happened in the following pages.

What just happened?

Coffee is a complex chemical mixture that contains more than a thousand different compounds. We use water to get some of these chemical compounds out of the grinds and into our cups. Of these compounds, some will dissolve into the water and some are insoluble. Most of the insoluble particles remain in the coffee bed; however some make it through the filter. The ones that make it through contribute to the mouthfeel of the brew.

The compounds that are soluble may contribute to the overall flavour. They extract at different rates, with shorter chain molecules dissolving quickly and the heavier, longer chain molecules at a slower rate. The shorter chains tend to be volatile while the longer chains are non-volatile. As we drink the brew, compounds run over our tastebuds and we'll perceive them as taste. The longer chain compounds also increase the mouthfeel of the brew. The short chain molecules may either stay in the liquid or fly off into the air as aromas that course up the back of our throats to our nostrils and land in a nest of receptors below the olfactory bulb.

The first flavour compounds to come out of the v60 cone are aromas. They are predominantly stored in the lipids that cling to the cell walls. The lipids are the first substances to diffuse into the hot water. Along with the undissolved solids and long chain molecules, they provide texture. Sour-tasting compounds then quickly dissolve and come out over the first few seconds of drip. After about the ten second mark, the sweeter-tasting compounds dissolve and start to be extracted. Later on, the bonds holding the longer chain, bittersweet compounds hydrolyse, and these compounds diffuse into the liquid and some will pass through the filter cone becoming a part of our brew. After a certain point, the remaining liquid will either be insipid or bitter.

Neither insipidity nor bitterness improves the flavour of our brew. We therefore need to stop the extraction at the point when we have more 'nice' in the cup than 'nasty'. The way to work out when to stop is simply to stop the test, taste the results, and learn for next time. We achieve the best brews through precise, repeatable experimentation.

Video 1.2 Compounds that we extract from coffee

This is a simplified timeline for the extraction of flavours, holding true for many ‘safe’ coffees. Some of the more interesting coffees, however, have both tasty and unsavoury flavours that come through early. The trick is to extract enough of the nice flavours to colour the bad and turn it into something that is interesting and delicious.

Coffee extraction

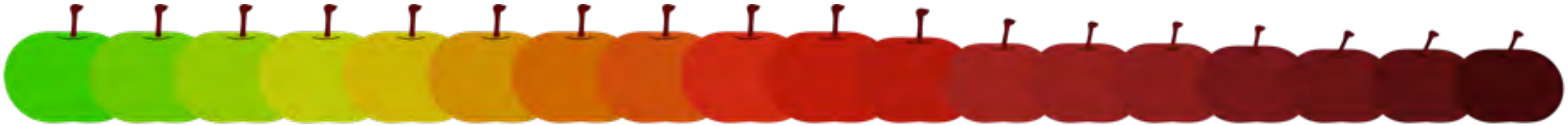
Extraction is your job.

It is fundamental to our game of coffee making.

We use water to extract the flavour compounds from coffee grinds. We control how much we extract and, to some degree, what flavours, but fundamentally all we are doing is using water to get the flavour out of coffee.

Amount of extraction

Extracting the right amount of coffee is like selecting a ripe apple. Not everyone agrees at what point an apple is ripe. We are unanimously sure, however, when an apple is *un*ripe because it will be very sour, as well as when an apple is *too* ripe, as there will be brown putrefaction patches spreading out over its surface. Different people will have preferences for different flavours somewhere between the extremes of ‘sour’ and ‘putrid’, but the sweetest apple possible is arguably the one you get just before the ‘nasty’ moves in.



The same can be said for coffee. We are all looking for the sweetest possible extraction without the dry or bitter flavours dominating the flavour mix. We call this spectrum of sour through sweet to bitter the **taste balance**.

Around 28% of the coffee bean is water soluble. However, extracting this much of the coffee would taste very bitter. On average, an extraction of around 18-22% usually falls into the zone of ‘tasty’. There’s a phenomenon that Scott Rao terms the 'double hump' in the *Professional Barista’s Handbook*. Some people find an area of around 15–16% extraction tasty. Vince Fedele of VST fame suggested that those people are just wrong, and I agree, but even so there *are* more fruity flavours in this area than there are in the 16–18% zone.

This phenomenon can lead to confusion when our trial shot is within this zone: if we make a brew that tastes too sour and we decide to grind finer for next time, we might be left finding that the second time round the brew still tastes sour, but also less interesting. It may be that the first brew was around 16% extraction, which is within the ‘double hump’, and we took the extraction outside of 16.8% by making the grind finer. We may need to go another couple of steps finer before we get to into the 18–22% zone.

18–22% extraction is a guide and can't be more precise because we're measuring an average extraction of the various sized coffee grinds (more of this in Chapter 3 on grinding), using beans from different origins, using water of different compositions (more of this in Chapter 2 on water) and using different preparation methods. We determine the ‘correct’ amount of extraction for a specific brew by tasting and adjusting the variables (more on these in the Manipulating the Flavour section) until we taste a good cup.

In the next few pages we look at the processes and factors that affect the extraction. This is the theory behind extraction and it get a bit dense in places. Persevere with it! It's not too much and it's important to your understanding of brewing so that you can get the flavours you want in the cup.

Contact time

Contact time is the time that the water spends in contact with the coffee grinds. It’s the easiest variable to manipulate, and for immersion brewing it’s the easiest variable to play with. Although flowrate, and therefore contact time, is an important variable in drip and pressure brewing, surface area plays a much greater role in determining the extraction rate in these brewing methods.

Surface area

The greatest factor that affects the rate of extraction is how much the coffee surface area is exposed to the water. We'll examine this in greater detail in Chapter 3 on grinding, but for now it's important to know the following: finer grinds equal an increased surface area, while coarser grinds equal less surface area.

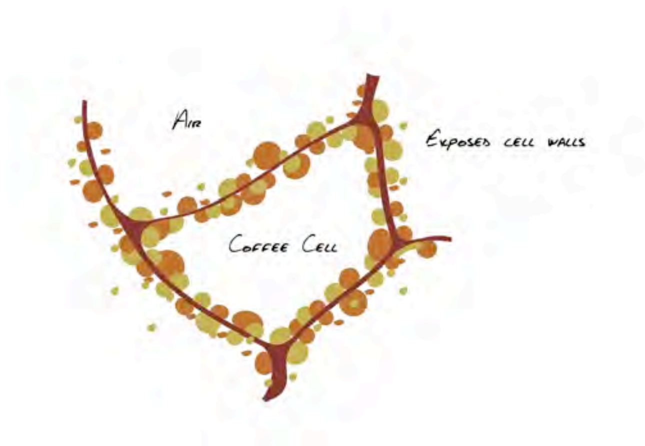
Evenness

Much of making good coffee comes from making it more 'even': we pick cherries for an even level of ripeness, we grade the beans so that they're evenly sized, we roast with high air-flow to roast the beans as evenly as possible inside and out, and we use grinders that produce particle grinds that are more even. The more even the coffee is, the easier it is to brew and the greater the clarity of the flavour will be. Variations in the coffee may add complexity, but that is inherent to the process and it is not our role to add to it. Our role is to simply extract as evenly as we can.

Extraction processes

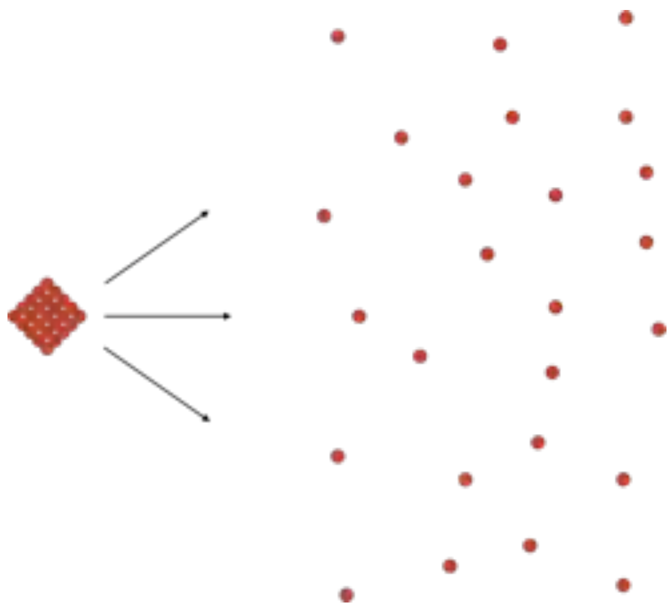
Several physical and chemical processes are at work when extracting flavour compounds from coffee grounds. **Diffusion** (Figure 1.5) pushes compounds from an area of higher concentration to an area of lower concentration, **hydrolysis** is when water reacts with insoluble compounds to loosen them from the cell walls, and **dissolution** works on water soluble compounds.

Video 1.3 Extraction processes



All of these processes work like an anti-capitalism mob ironically looting an electronics store: smashing windows, prying open shutters, storming right through the front door and carrying out everything that isn't nailed down. The first to go are the items on the shelves outside the shop. Then someone smashes the window and his mate takes the items in the window display. Next, someone breaks in and the phones and gadgets are passed out, followed by the SLR cameras. After some organisation, the doors come off their hinges, the mob teams up to carry off the heavy wide-screen televisions and, finally, all the furniture and fittings.

Figure 1.5 Diffusion



It's a similar process with coffee: as the water washes through the coffee grinds, any loose items are carried off first. Then the water surrounds the coffee cell, and the exposed soluble compounds quickly start to dissolve. The water next reacts with some insoluble compounds as well as some of the larger soluble compounds, prying them off the cellulose walls. The gas inside the coffee cells expands as it heats up and the cell floods with water. This creates a pressure gradient across the cell wall that the compounds move across by diffusion.

Turbulence

Turbulence speeds up the rate of extraction. It can be caused by agitation, any shaking or stirring action (Video 1.4), pouring, or gas escaping. Turbulence is chaotic and impossible to repeat exactly. However, we will always use some kind of turbulence in our coffee preparation, just adding water to the coffee is turbulent and so is stirring to wet all of the grinds.

Video 1.4 Turbulent versus still brewing

We can observe the difference between still and turbulent brewing by placing two tea bags (not, dear barista, that I presume you to ever drink anything but loose-leaf) into two separate glasses of water at the same time. Leave one to soak and stir the other for 10 seconds. Remove the tea bags and observe the difference in colour between the two glasses.

Generally speaking, it is better to keep turbulence to a minimum. However, turbulent extraction may produce different, sometimes even better, results. If preparation allows, experiment with both still and turbulent extraction methods.

Concentration

Concentration, or strength, is often misunderstood. People often use strength to refer to the roast level of the coffee beans and the viscosity or the intensity of the brew. Concentration is a measure of the dissolved solids (coffee) in the brew (beverage). It should be considered, as James Hoffmann once put it, in the same way as the percentage of alcohol on the label of your favourite beer.

Concentration is like a bus of 38 people pulling up outside a Starbucks and a Bitches' Brew Coffee. Starbucks has a seating capacity of 100 and Bitches' Brew Coffee has a seating capacity of 16. 20 of these people go into Starbucks and 18 go into Bitches' Brew. Although Starbucks has 'extracted' more people out of the bus, it's quiet, sterile and dull inside, with only 1/5 of the seats taken. Bitches' Brew, however, is humming with people. The concentration of people at Starbucks (20/100 = 20%) is much less than at Bitches' Brew (18/16 = 112.5%).

For coffee brews, we measure concentration in Total Dissolved Solids (TDS). In the above example, the people in each of the cafes are like dissolved solids and the size of the cafe represents the volume of the beverage. TDS is the dissolved coffee as a percentage of the entire volume of coffee. Because 1 mL of water is close to 1 g of water, it's easier in practice to measure volume in grams.

For immersion or drip brewing methods, TDS is usually around 1.1-1.5%. For espresso, it's usually around 8-14%. So a weak brew of drip coffee is around 98.9% water and 1.1% coffee. A strong brew is 98.5% water and 1.5% coffee.

The TDS percentage is the amount of extracted coffee in the beverage:

TDS (%) = dissolved solids (g) / beverage weight (g) x 100

We can also work out the TDS from the extraction percentage by using this formula:

TDS (%) = extraction (%) x dose (g) / beverage weight (g)
(or, put more simply: strength = extraction x brew ratio)

The 'beverage weight' is the liquid coffee, also known as 'yield'. The latter formula is the one we use for drip or pressure brewing. For immersion brewing, we substitute the beverage weight for the brew water weight.

For those of you who are more visually minded, take a look at the coffee brewed using the v60 preparation method in Figure 1.6. We grind the beans, add the water and brew the coffee. The spent grinds are left behind in the filter paper and the dissolved solids go into the beverage.

Boiling the water off the brew will leave behind a fine powder. The TDS is the weight of this powder given as a percentage of the weight of the whole beverage (water and dissolved solids together).

Figure 1.6 Working out the TDS

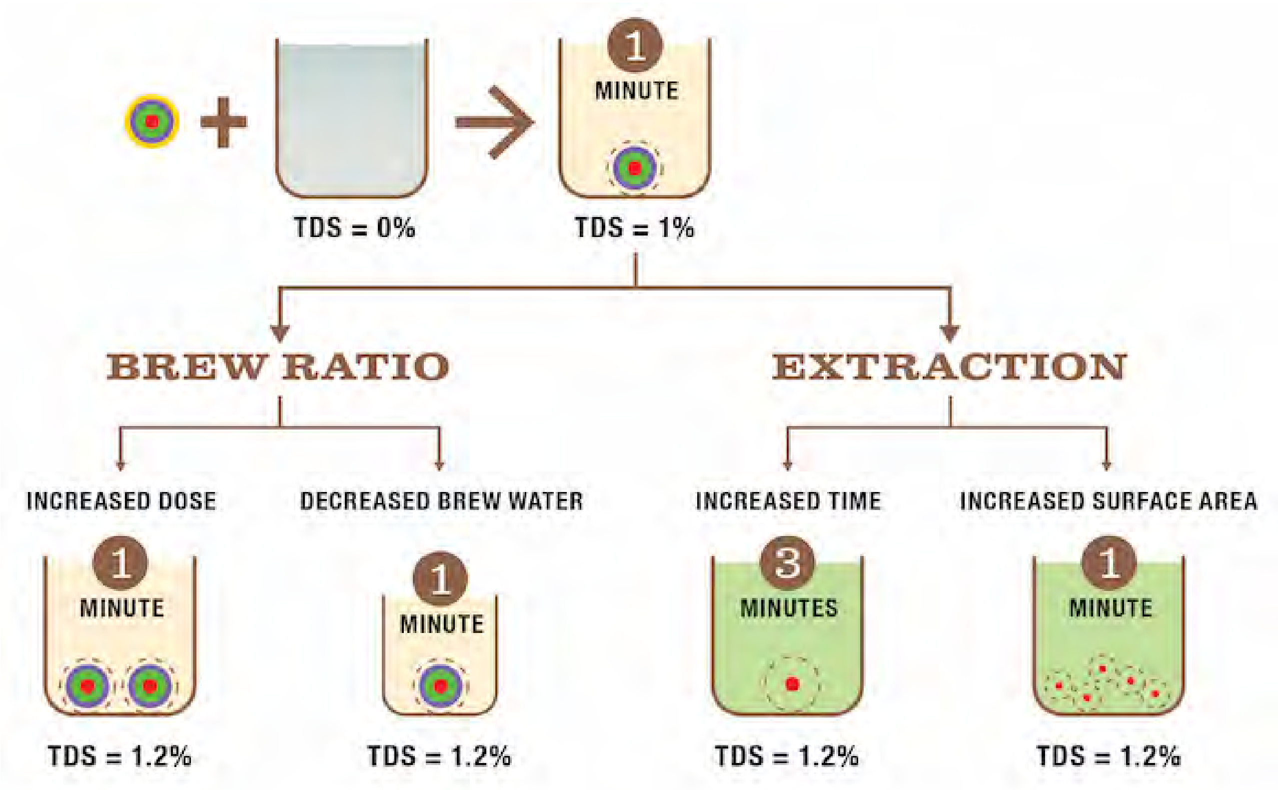
Measuring the TDS doesn't tell us much about what's in our coffee. It's like talking about the opacity of the liquid rather than what colours make it up.

There are two ways to change the coffee strength: (1) change the brew ratio by changing the dose or brew water, or (2) extract more or less from the coffee grinds. We can end up with the same TDS and very different tasting coffee. To understand why, let's get out the gobstoppers…

Gobstoppers, for anyone with a deprived childhood, are hard round sweets that are made up of multiple layers, each of a different colour and flavour. If we take a gobstopper and put it into a cup of acid, the layers would start to dissolve and we would see the acid change colour, much as water changes colour when we add our coffee grounds. The opacity, or thickness, of the colour in the acid is like the TDS, and tells us that there is a level of colour in the acid, but doesn't tell us what layers the colours came from.

Let's say that it takes 1 minute to dissolve the first layer on a normal sized gobstopper and a little more for each subsequent layer. We can change the opacity of the acid by changing the ratio of gobstopper to acid. Even if we keep the time at 1 minute, the opacity would change because we've either more or less gobstopper or more or less acid. This is the effect of changing the brew ratio. We can also change the opacity by dissolving more layers by changing the time, by using different sized gobstoppers to change the surface area exposed to the acid, by stirring the mixture or by changing the temperature. This is the effect of changing the extraction. Have a look at Video 1.5 to see this graphically.

Video 1.5 The relationship between TDS, brew ratio and extraction



Strength is a matter of personal preference, as evidenced by the wildly different TDS recommendations from the Norwegian and American coffee associations in Table 1.2. One Norwegian's 'rich' may be an American's 'intense', whereas an American's 'gentle' is, to the hardy Norwegian, 'insipid'.

Table 1.2 Various coffee associations' guidelines

	Extraction min	Extraction max	TDS min	TDS max
Norwegian Coffee Association	18	22	1.30	1.55
Speciality Coffee Association of Europe	18	22	1.20	1.45
Specialty Coffee Association of America	18	22	1.15	1.35

Refractometer

The process in Figure 1.6 is laborious and made redundant if you happen to have a light source, a prism and a linear detector array (a.k.a. a refractometer – Figure 1.7) at your disposal. A refractometer shines a light through a sample of the coffee and measures its temperature and refractive index. From this, it can infer the TDS. The refractometer doesn't measure extraction, but by using the TDS, knowing our brew ratio and using the second TDS formula or the CoffeeTools app, we can work out how much coffee we've extracted.

Figure 1.7 VST refractometer

Not every cafe has a refractometer sitting around in a drawer. Even if your cafe does, customers might be less than impressed if you pulled it out to check extraction percentage mid-service – especially if you're waiting for your sample to cool to room temperature before taking the reading. However, the refractometer is a great bit of kit to train our judgment of extraction and help us quickly get into the zone of good tasting coffee. If we use it to **dial in** at the start of the day, it can really help us to understand how the changes we make affect the extraction and TDS of the brew.

Coffee brew ratio

In coffee-making, we use the terms 'dose' for coffee grinds, 'brew water' for water, and 'beverage weight' for liquid coffee. The brew ratio is the ratio of the dose to the brew water and is written as: X g dose/X g brew water or as a simple number ratio X:X. Since the popularisation of the VST refractometer, many people have preferred to reduce the figure to a simple number dose multiple, so 12 g coffee to 200 g water becomes 16.7. Although I prefer the elegance of this, it confuses many people. To keep it clear, I'll use the form X:X, in this case 1:16.7.

We use ratios for coffee, just as we do with recipes. For example: a meringue is egg white and sugar baked to gooey chewiness encased by a crisp, crunchy, sugary shell. 1 egg white and 60 g caster sugar would make 4 meringues.

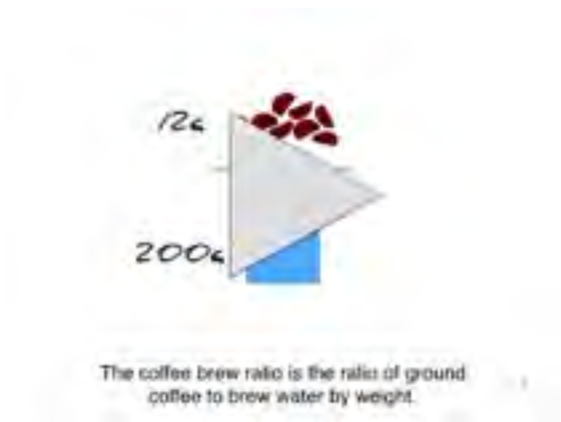
We can easily make any number of meringues by using the ratio of egg whites to sugar, which is 1 egg white to 60 g sugar or 1:60. If we wanted to produce 20 meringues, we'd simply multiply this ratio by 5 (20 meringues/4 meringues = 5). Therefore, we'd need 5 egg whites and 300 g sugar.

That's enough of the sugar, kids! Preferences for brew ratio of drip and immersion brewing vary from 1:25 to 1:10 in different parts of the world. Because immersion brewing leaves more extracted coffee in the coffee bed, most people prefer a higher brew ratio for immersion brewing. It's okay to have your own preference – flavour is subjective. I encourage you to ignore what everyone else in your town is doing and to experiment with different brew ratios. I'll give you my own preferences in the next section.

Question: If you want a coffee brew ratio of 1:13.3, what dose would you need to brew with 200 g of water?

The answer is at the bottom of the page. If this question's still grinding down your bean, check out Video 1.6 on ratios.

Video 1.6 Ratios



We don't use 'coffee brew ratio' for espresso because it's more difficult to measure the brew water. We'll look at the espresso brew ratio later. For now, let's now have a closer look at the dose, brew water and beverage weight.

Answer to question above: 200 g / 13.3 = 15 g.

Dose

The dose is the weight of the coffee grinds that we're using. When we change our dose, we change the brew ratio and therefore the strength of the beverage. For immersion brewing, changing the dose results in a relatively proportional change in flavour. However, for drip and pressure brewing it gets a bit more complicated.

In drip and pressure brewing, changing the dose to alter the beverage concentration will also change the preinfusion rate, flowrate, extraction evenness, extraction yield, extraction temperature and total permeable grinds.

For these reasons, it's generally better to start with a certain dose and just work with it.

That's not to say that you should never change the dose to alter the flavour. If you're mid-shift, half-way buried in chits and have just changed to a new bag of coffee that's tasting a bit insipid, upping the dose may give it the kick it needs. That being said, it's still a compromise not entirely unlike snorting amphetamines to get a job done: it may work temporarily, but your customers (and workmates) are going to suffer in the long run.

Figure 1.8 Fines blockage

Excessive fines may cause blockage and uneven extraction, even in filter coffee.

Increasing the dose also means we're increasing the total fines in our slurry. Being highly mobile, fines can cause blockages and uneven extraction in drip and pressure brewing (Figure 1.8). We address fines more thoroughly in Chapter 3 on grinding but for now it's important to remember that preinfusion, stirring and pouring evenly help to reduce clogging and uneven extraction.

Just one more point to note concerning dose: even if they're the same model, coffee grinders are far from uniform. Each set of grinding burrs will produce a different spread of grinds, and a 20 g dose from Grinder A won't necessarily give the same surface area as the same dose from Grinder B.

Brew water

The brew water is the water we add to the dose. It acts as a solvent for extracting coffee compounds from the grinds.

If we increase the dose and want to extract the same flavour from our coffee, we need to add more water to maintain the brew ratio. This is what we do when we cut an espresso pour at a similar extraction point at '**blonding**'.

If we change the amount of brew water while keeping the dose itself fixed, we change the concentration of the beverage. In immersion brewing, increasing the brew water will increase the temperature throughout the infusion and increase the extraction. In drip and pressure brewing, pouring more water through the coffee bed extracts more coffee by increasing the contact time while increasing the beverage weight (see Beverage weight on next page). Still, this is far less complicated than if we change the brew ratio using the dose.

So remember: if you want to change the concentration, it's simpler to change the amount of brew water than it is to change the dose.

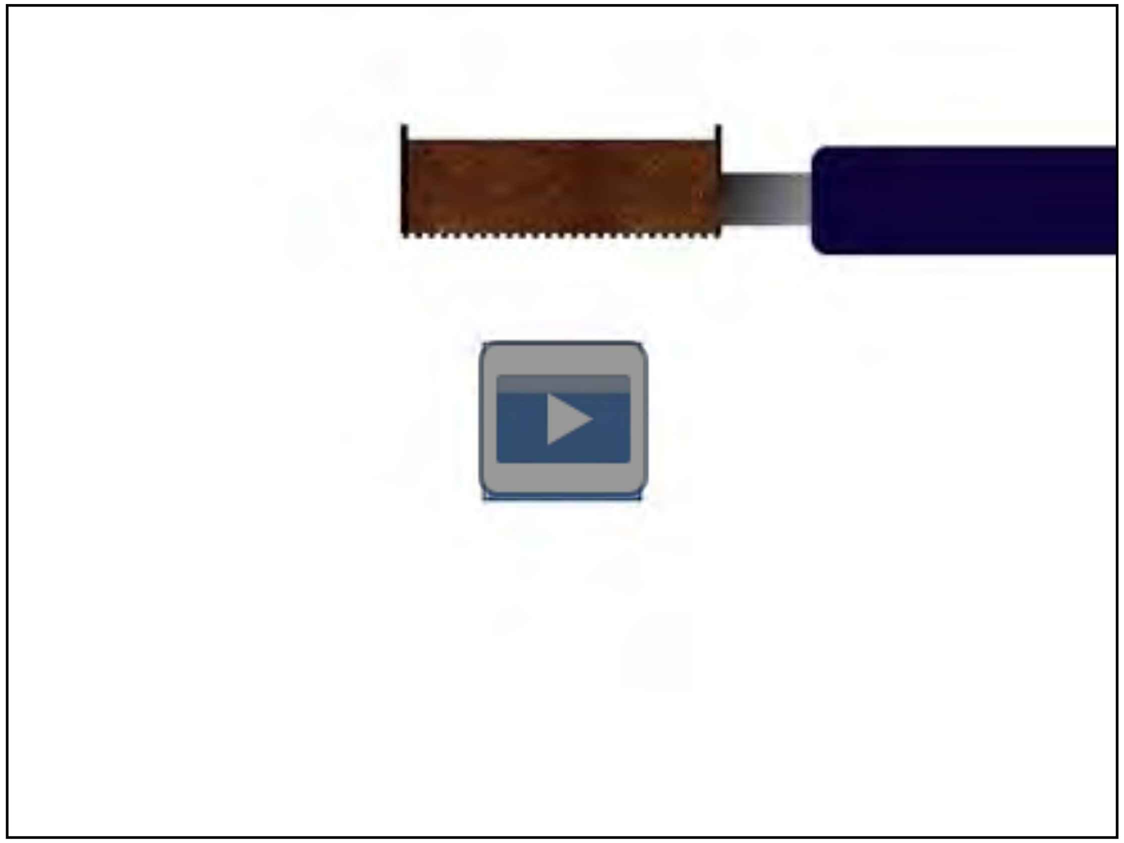
The other way that water can get into the brew is directly into the cup. This is called dilution. Dilution is not part of the brew ratio. Rather, it lowers the concentration of a solution by increasing its volume. We can make a long black from a short black by adding water (diluting it). Diluting a brew doesn't affect extraction.

Once water has gone into the cup, there may be a little more extraction of some of the larger compounds that got there through hydrolysis, but these compounds would extract without the added water. Generally speaking, the process of extraction is over; all we're doing is diluting the beverage.

Beverage weight (brew yield)

In drip and pressure brewing, beverage weight is the term for the yield in the cup. If a farmer sows her field, the yield will be the weight of coffee cherries she harvests. If we place coffee grinds in washed filter paper and pour water over them, then our brew yield is what we get in the cup below.

Video 1.7 Concentration, dilution and beverage weight



The beverage weight is made up of all the water we put in and the extracted coffee, minus the water still soaking in the grinds. As we saw in Video 1.6, we get more coffee in our brew either by increasing the dose-to-water ratio (so decreasing the brew yield), or by extracting more. To extract more, we either need to increase the brew water-to-dose ratio, which increases the brew yield, grind finer to increase the surface area or simply brew for longer. We brew for longer by increasing the preinfusion time or grinding finer or by manually or mechanically slowing the flowrate.

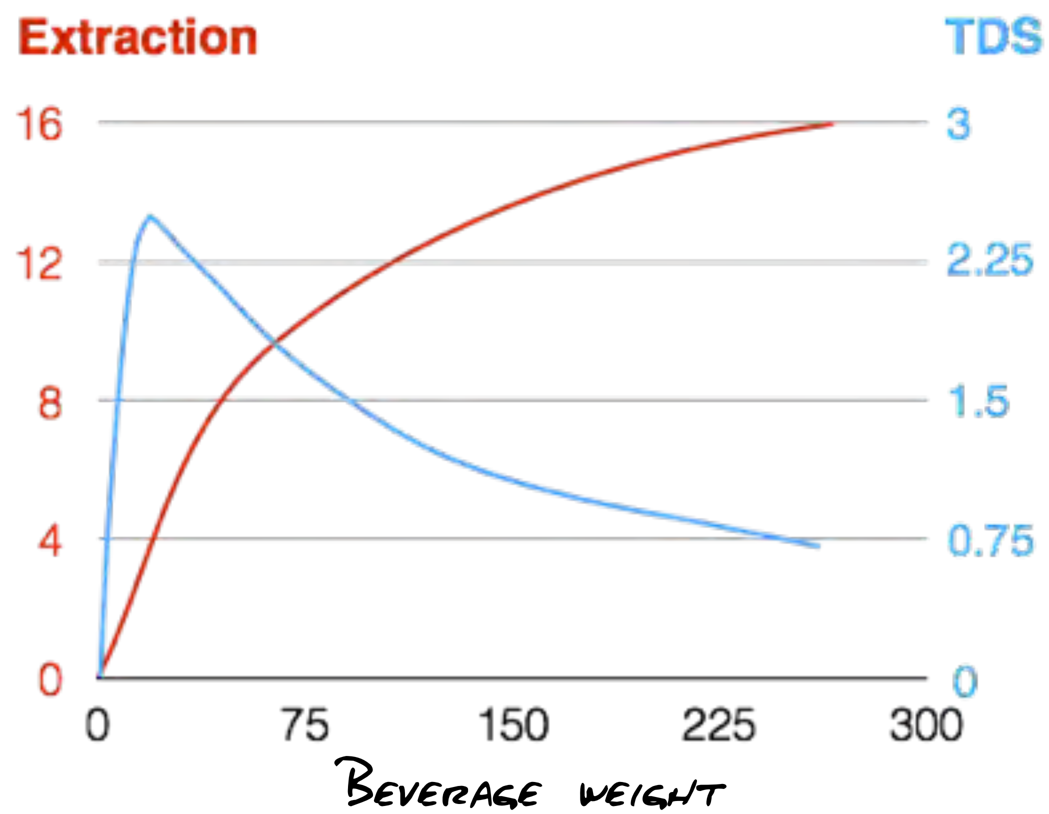
Video 1.7 illustrates the differences between concentration, dilution and beverage weight.

If all that seems a little too complicated, it's because our *ménages à trois* of beverage weight, concentration and extraction is easy to misinterpret. One extreme is a brew that's strong, thick, aromatic and sour, and the other extreme is a brew that's weak, thin, dull and bitter. The ratios in between these extremes are the ones that we want: those that create a sweet and complex partnership of aroma, mouthfeel, body and aftertaste. What those ratios are and what's best for you and your customers is, as poly-relationships always are, a compromise, entirely personal, and best worked out through clear communication.

Look at the graph in Figure 1.9. The beverage weight is given on the bottom (x-) axis and increases as our cup fills up. Extraction starts low and increases as we pour more water through the coffee grounds. The concentration (TDS) shoots up as the water washes out the loose compounds and extracts the fines; as the beverage weight increases, the concentration will decrease, despite continued extraction.

If we were to stop pouring the water at 60 g, the result would be an overpowering TDS of 1.85% and a sour 9.4% extraction. At 250 g, our TDS will be a flaccid 0.75% and the 16% extraction will be so drowned in water that it'd be hard to detect its tart sweetness. In short, nowhere on this graph would we get a decent brew.

Figure 1.9 Concentration and extraction vs. yield



In this case, the idea is to increase the extraction *without* increasing the beverage weight. We can do this by increasing the dose, preinfusion time, or by grinding more finely. As changing the brew ratio only complicates matters and changing the preinfusion time is too fine an adjustment, the best option, in this scenario, is to change the grind size to push up the extraction curve.

A summary of the effect of some of the variables above is shown in Table 1.3.

Table 1.3 Effect of variables on extraction

Extraction	Less	More
Grind size	Coarser	Finer*
Contact time	Shorter	Longer
Turbulence	Less	More
Water	Less	More

**Beyond a point, grinding finer will start to decrease extraction for pressure brewing.*

That's the end of the background theory of coffee extraction. Next we'll look at the practice of brewing coffee before having a closer look at how we can combine the theory and the practice to manipulate the flavour of our brew.

Brewing methods

Brewing methods are those that we use to extract the coffee. This is not the same as the preparation methods, which refer to the method we use to brew using specific preparation devices such as the syphon, cafetière (French press), espresso machine, etc.

Most preparation methods have characteristics of different brewing methods. However, we can give a general picture of the main methods of brewing: immersion, drip, and pressure.

Immersion

Immersion

For this method, the coffee is completely immersed in water throughout the percolation. When we pour the coffee out, the water remaining with the grinds has the same concentration as the brew. To obtain the same strength as a drip coffee, use a higher brew ratio for immersion brewing or brew with an added flush. Examples are: camp coffee, filter bags, ibrik, cafetières, steampunk, aeropresses, syphons, clever drippers, and trifectas.

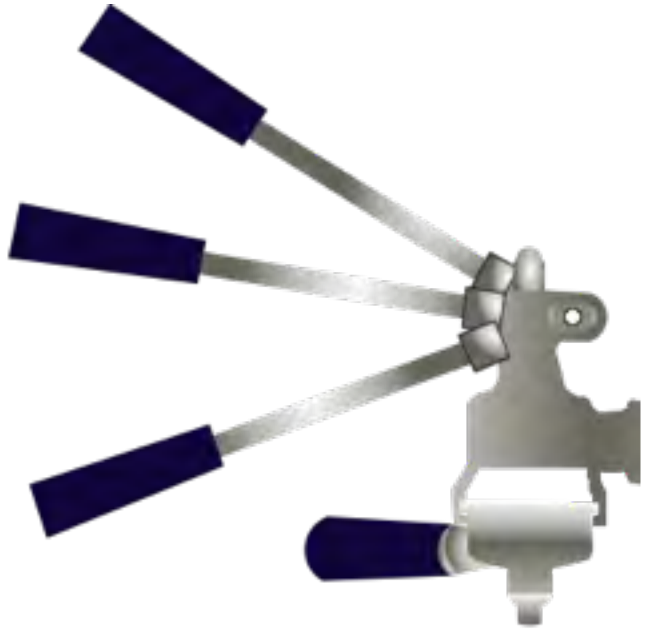
Drip

Drip

For this method, the water passes through the bed by gravity and can be manipulated by the rate of pouring. Examples are: v60 filter cones, automatic drips, mellita cones, chemex and phoenix.

Pressure

For the pressure method, water is forced through the coffee ground bed under pressure. This is commonly known as 'espresso' and the standard is 9 bar at 90–97ºC (194–207ºF).



Pressure

Other methods

Stimulated baristas are always coming up with more ways to steep. Cold brewed coffees are becoming more common and there are many new devices coming out that use vacuum.

Cold coffee

Ice-drip, cold brew and nitrogenated coffees used to be the sole domain of specialist shops but are now becoming more mainstream in third-wave cafes. Due to the difference in brewing temperature, ice-drip doesn't behave like drip coffee and cold brew doesn't behave like immersion brewing.

Vacuum

The molecular gastronomy movement started playing around with vacuum extraction and the ever-excitable coffee community naturally took it in with open arms. Many people use the vacuum chamber used to seal coffee bags at roasteries.

There are several preparation devices that use vacuum to extract the grinds: the BKON uses cycles of vacuum and immersion to extract compounds from dried food and coffee. Ground Control from Voga Coffee uses cycles of immersion and vacuum to layer up extraction flavours in their batch brewing system. The method has interesting possibilities, and can extract more from less coffee, but is not yet widespread.

Video 1.8 Brewing methods

Further considerations

Chaff

Unpolished green beans have thin silverskin around them. Most of the silverskin comes off during roasting and we call it 'chaff'. In darker roasts, nearly all the silverskin comes off but we can still see it nestled in the cracks of lighter roasted beans.

Chaff tastes like boiled wood and termites love it but baristas should avoid it. When grinding the beans for filter coffee, much of the chaff sticks to the inside of the grinding chute. This is a good thing. Then the barista flicks the knocker a couple of times and the chaff flitters like decaying butterflies into the cup. This is a bad thing.

Video 1.9 Chaff

Watch for the chaff falling after the flick.

Bloom

Fresh coffee has gas, mostly carbon dioxide (CO_2), trapped within the beans. About half of the CO_2 in freshly roasted coffee is released within five minutes of grinding. When we pour hot water onto our fresh grinds, the gas releases to form a floating mass of grinds and CO_2 called the ‘bloom’ (CO_2 isn’t soluble above 80ºC (176ºF)). Although fresher coffee is generally best, it also has more CO_2 to release and too much bloom can keep some grinds separated from the water for too long, leading to the underextraction of those grinds. Stir the bloom to extract the grinds more evenly.

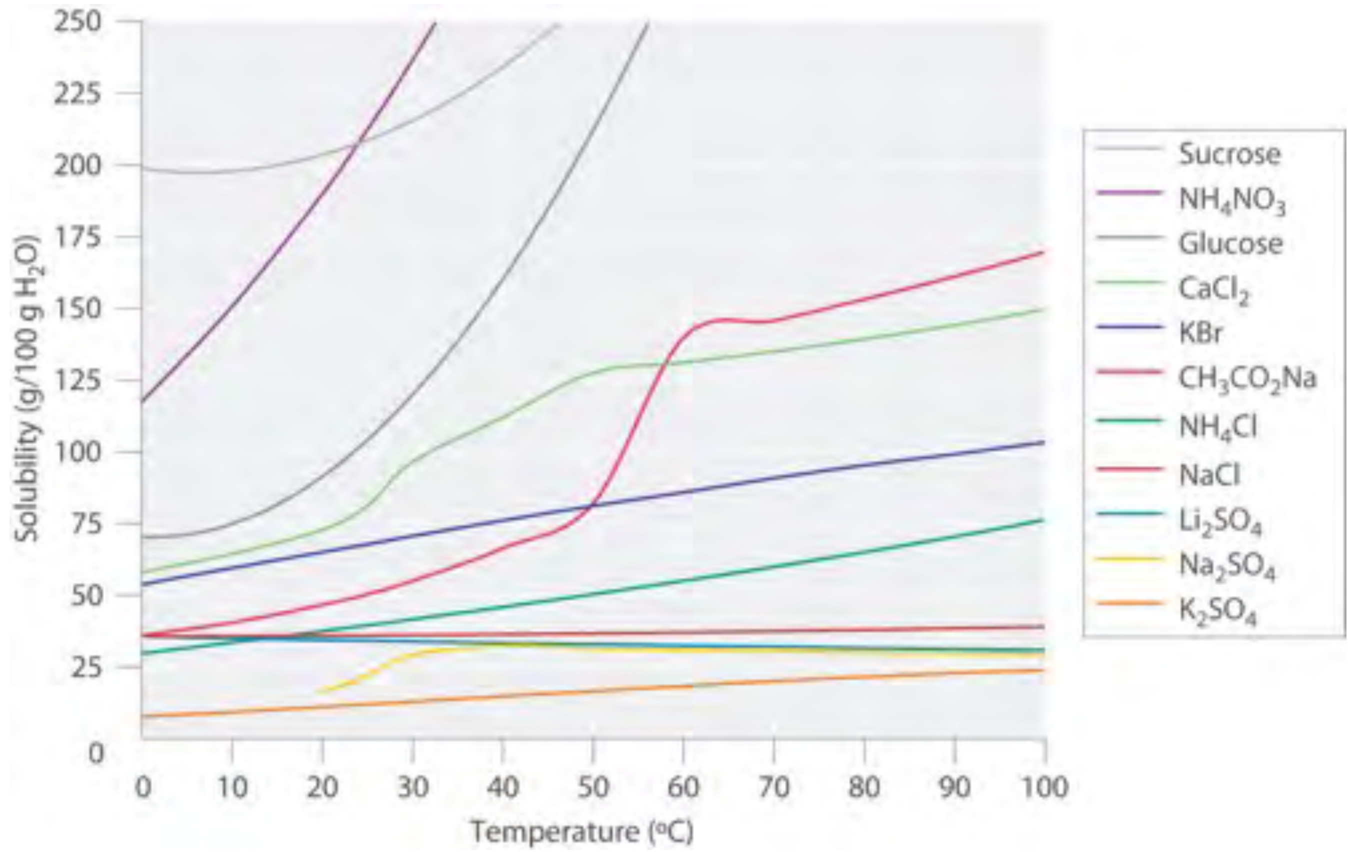
Temperature

Most organic compounds become more soluble at higher temperatures as the water has greater thermal energy to enable reactions with the compounds. However, as shown in Figure 1.10, the solubility of organic and inorganic compounds varies widely between different compounds and some compounds become less soluble at higher temperature.

We can change the temperature of the water that we use in order to manipulate the flavours we extract. Even so, as we'll see in Chapter 2: Water, extraction is complicated enough as it is without having to change the temperature of water as well. Feel free to experiment, but be aware that with temperature fluctuation, you're only adding another layer of complexity to an already elaborate system.

To get consistent brews, we need to ensure that the temperature profile is always the same during our brewing process. That's not the same as a constant temperature: to get a constant temperature throughout the extraction process, we need to use a high-end espresso machine or a brewing device that maintains the set temperature. A consistent temperature profile means that the water at any given time will have the same

Figure 1.10 Solubilities of Several Inorganic and Organic Solids in Water as a Function of Temperature



Averill, Eldredge. Principles of General Chemistry, 2012.

temperature from brew to brew. So, if the initial temperature of one brew is 100ºC (212ºF) and the temperature in the slurry at 2 minutes is 70ºC (158ºF), then a consistent second brew would also need to have an initial temperature of 100ºC (212ºF) and 70ºC (158ºF) at 2 minutes. Most preparation methods vary significantly in temperature throughout the brewing, but as long as the environmental temperature is the same, with careful attention, the profile and the resulting flavours in each brew can be replicated.

For consistent immersion brewing, ensure that the amount of water we use is consistent between brews. More water has higher thermal mass, and supplies more heat energy resulting in faster and possibly different extraction. Best practice is to weigh your water first, then quickly add the pre-weighed grinds to ensure that the thermal mass is the same each time.

For consistency, use water straight off the boil. The water will always be 100ºC (212ºF). It's a common assertion that boiled water 'burns' coffee. It doesn't. If your coffee has been roasted for use with boiled water, it'll taste great. Using water straight off the boil means you can forget temperature as a variable and concentrate on the other variables of flavour manipulation.

A good deal of heat is lost between the kettle and the slurry in drip brewing. Even using water from the boil the temperature in your slurry is likely to go lower than 75ºC (167ºF) during the extraction. To keep the slurry temperatures high, you need to pre-heat the equipment as well as using water from the boil.

Although I advocate using hot water, using water at different temperatures does produce different results and I'm all for consistent experimentation. There are kettles that heat up to specific temperatures before cutting out; alternatively, it is possible to change the temperature by adding a measured dose of cold water to the boiled water.

Filters

At some point we want to remove our brew from the coffee grinds. We usually do this using a filter. The type of filter we use will affect the flavour and texture of the brew. There are various types of filters and using a different filter with the same preparation method produces markedly different results. Filters dictate the size of the grinds that make it into the brew, the amount of oil that gets through, and they also affect the flowrate and drawdown time.

Most filters are made from paper or metal. Paper filters should be washed before use, to prevent adding paper to your tasting notes. Metal filters should be cleaned often to prevent old coffee residues contaminating the flavours of your fresh brew.

Stale coffee

Coffee only really goes stale when oxygen degrades the flavour aromas and the oils go rancid. The rate at which the flavour compounds become damaged after grinding is often exaggerated: depending on how the grinds are stored, we can still get half-decent coffee from them, even if they are several weeks old. However, as grinds rapidly absorb smell and moisture, it is best practice to use the grinds as soon as possible after grinding.

A more important point to consider over staling is the consistency in CO_2 levels between brews. Different amounts of CO_2 lead to different levels of bloom and different flowrates. The best way to get consistency is to grind the beans and brew from them immediately.

Now that we've had a look at what goes on when we brew, it's time to look at the brewing methods to see *how* we brew.

1.2 Key learning points

1. There are many chemicals in coffee and we don’t want all of them in our cup.
2. It is possible to extract 28% of *arabica* coffee.
3. Average extractions of 18-22% are likely to taste nice.
4. The more even the coffee grinds, the more even the extraction.
5. Turbulence increases the rate of extraction.
6. Concentration = strength = TDS.
7. The ‘dose’ is the weight of coffee grinds.
8. The ‘brew ratio’ is the ratio of the dose to the brew water.
9. The ‘beverage weight’ is the weight of the brew in your cup and is also called ‘brew yield’.
10. As the beverage weight increases, the extraction increases and the concentration decreases.
11. There are three main types of brewing methods: immersion, drip, pressure.
12. We need to brew with consistent temperatures to get consistent flavours.

Review of Thinking About the Brew

Question 1

What are the first flavour compounds to be extracted from coffee?

A. Sour compounds
B. Acids
C. Aromatics
D. Oils

Question 2

What is the first taste that is extracted from coffee?

A. Sour
B. Bitter
C. Salty
D. Sweet

Question 3

What's the maximum coffee % that water can extract at below 100°C (212°F) and one atmosphere?

A. Until it's bitter
A. 1.35%
B. 28%
C. 18 - 22%

Question 4

Which coffee grinds have the greatest surface area?

A. Fine
B. Coarse

Question 5

Which three processes help to extract coffee in water?

A. Hydrolysis
B. Diffusion
C. Dissolution
D. Deliquescence

Question 6

What is the result of turbulence?

A. CO2 expands out of the coffee cells
B. More extraction occurs
C. Faster extraction occurs
D. The liquid carbonises

Question 7

What is otherwise known as the strength of the coffee? (Choose all that apply)

A. The roast level
B. The concentration
C. The percentage of total dissolved solids
D. The ratio of coffee to milk

Question 8

If a filter coffee has a TDS reading of 1.35%, what percentage of the brew is water?

A. 30%
B. 100%
C. 98.65%
D. The extraction percentage minus 1.35%

Question 9

"Concentration is a measure of the _________ (coffee) in the _________ (beverage). It should be considered in the same way the percentage of cocoa on bars of chocolate." Choose the missing words.

A. Grinds
B. Dissolved solids
C. Brew
D. Slurry

Question 10

What level of extraction tastes good?

A. We'll only know when we try it
B. 19%
C. 30%
D. 16 - 18%

Question 11

What average percentage of extraction usually tastes good?

A. Total extraction divided by the number of grinds
A. 18 - 22%
B. 28% at one atmosphere
C. 16 - 18%

Question 12

How do we measure concentration in the speciality coffee industry?

A. Dissolved solids
B. g/L
C. Number of moles of the solute divided by the volume of the solution
D. Total dissolved solids

Question 13

What is the ‘double hump’?

A. The effect in heat-exchange machines requiring a cooling flush
B. The sandy feeling you get from too many fines in the cup
C. The area of increased fruitiness at around 15-16% extraction
D. When the pump is required for both brewing and filling the main boiler

Question 14

Which are the two correct equations for working out the TDS?

A. TDS (%) = brew ratio (g/g) x coffee grounds (g)
B. TDS (%) = dissolved solids (g) / beverage weight (g) x 100
C. TDS (g/L) = coffee grounds (g) / liquid coffee (mL)
D. TDS (%) = extraction (%) x dose (g) / beverage weight (g)

Question 15

What does a refractometer measure? Choose all that apply.

A. Extraction
B. Total Dissolved Solids (TDS)
C. Refractive index
D. Coffee solids
E. Temperature

Question 16

One coffee uses 9 g coffee grinds to 200 mL water and another coffee uses 16 g coffee grinds to 150 mL water. Which coffee has the greatest concentration?

A. 9 g / 200 mL
B. 16 g / 150 mL
C. The concentrations are the same
D. We can't tell because we don't know how much coffee was extracted

Question 17

A coffee brew ratio of 1:16.7 gives us how many grams of coffee to 100 g of water?

A. 0.6

B. 1.67

C. 16.7

D. 6

Question 18

"Preferences for brew ratio of drip and immersion brewing vary from _____ to _____ in different parts of the world." Choose the missing ratios below.

A. 1:1

B. 1:4

C. 1:25

D. 1:10

Question 19

Changing the dose in drip or pressure brewing changes which of the following? (Choose all that apply)

A. Preinfusion rate

B. Flowrate

C. Extraction yield

D. Extraction temperature

E. Total fines

F. Extraction evenness

Question 20

How do we measure the brew yield? (Choose all that apply)

A. Weigh the liquid in the cup

B. Weigh the brew water

C. Use a refractometer

D. By beverage weight

Question 21

If I use 15 g of coffee to get a brew yield of 200 g and my extraction is 20%, by how much will I reduce my extraction if I add 50 g of water to the cup?

A. 4%

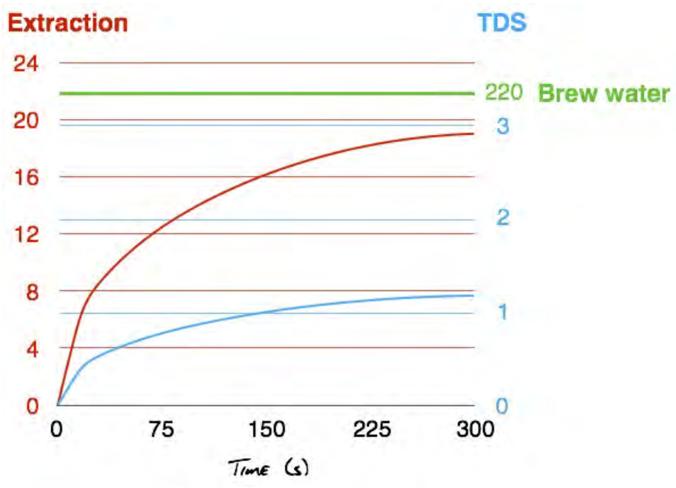
B. 25%

C. 1.25%

D. No change

Question 22

Is this brewing method immersion, drip or pressure?



A. Immersion

B. Drip

C. Pressure

Question 23

Which brewing methods do the pictured preparation devices use?

Immersion, drip & pressure (choose one for each preparation)

Question 24

Which of the following preparation devices use the immersion brewing method?

A. Melitta

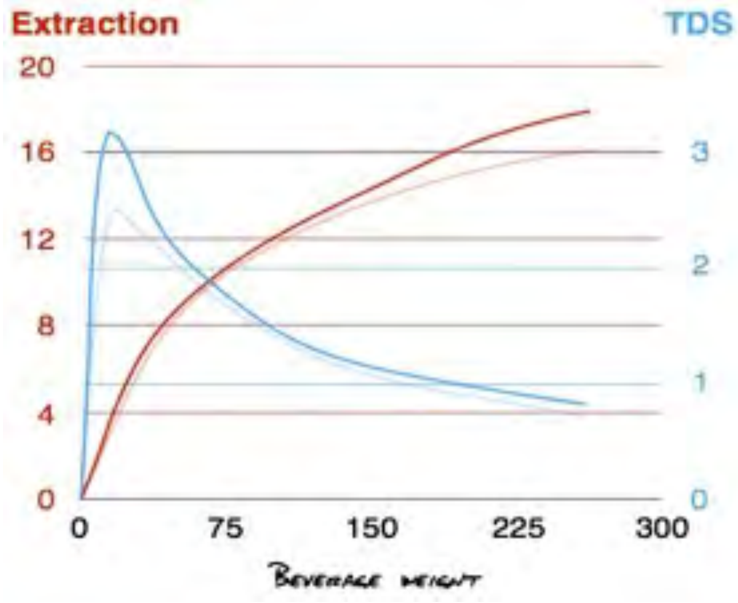
B. Ibrik

C. Syphon

D. Clever Coffee Dripper

Question 25

Changing which variable would most likely change the graph results from the faded to the brighter curves?



A. Increased dose

B. Decreased dose

C. Finer grind size

Question 26

What are the three main types of brewing method? (One answer)

A. Agitation, diffusion, dissolving
B. Immersion, drip, pressure
C. Turbulence, diffusion, dissolving
D. French press, v60, espresso machine

Question 27

Which gas is the most prevalent in the coffee bloom?

A. Carbon monoxide
B. Carbon dioxide
C. Sulphur dioxide
D. Methane

Question 28

At what temperature does water boil at one atmosphere?

A. 100ºC (212ºF)
B. 125ºC (257ºF)
C. 96ºC (205ºF)
D. 70ºC (158ºF)

Question 29

If we want the temperature in our v60 slurry to be 91-94ºC (196-201ºF), how high should we heat the water in the kettle?

A. 94ºC (201ºF)
B. 100ºC (212ºF)
C. 91ºC (196ºF)

Question 30

Water that is just off the boil will end up burning the coffee.

A. True
B. False

Question 31

When is coffee considered to be stale? (Choose all that apply)

A. Five minutes after grinding
B. When oxygen degrades the aromatics
C. After one month
D. When the coffee oils become rancid

Review 1.2 Answers

Question 1

Correct answer: C

Question 2

Correct answer: A

Question 3

Correct answer: C

Question 4

Correct answer: A

Question 5

Correct answers: A, B, C

Question 6

Correct answer: C

Question 7

Correct answers: B & C

Question 8

Correct answer: C

Question 9

Correct answers: B & C

Question 10

Correct answer: A

Question 11

Correct answer: B

Question 12

Correct answer: D

Question 13

Correct answer: C

Question 14

Correct answers: B & D

Question 15

Correct answers: C & E

Question 16

Correct answers: D

Question 17

Correct answer: D

Question 18

Correct answers: C & D

Question 19

Correct answer: A, B, C, D, E F

Question 20

Correct answers: A & D

Question 21

Correct answer: D

Question 22

Correct answer: A

Question 23

Correct answer: Red cup drip; French press immersion; black cup pressure.

Question 24

Correct answers: B, C, D

Question 25

Correct answer: C

Question 26

Correct answer: C

Question 27

Correct answer: B

Question 28

Correct answer: A

Question 29

Correct answer: B

Question 30

Correct answer: B

Question 31

Correct answers: B & D

Brewing Methods

Model: Megan Louise Wyper. Photo by Astra Plepe.

Overview

There are as many different preparation methods for brewing coffee as there are schisms in the world's religions. It's wise not to be dogmatic when it comes to brewing, partly because baristas with heightened dopamine levels in their pre-frontal cortices frequently come up with better ways to use an old device.

When evaluating a preparation method, don't let the rush of caffeine force these two considerations from your pre-frontal cortex: **repeatability** and **flavours**.

There is no best way to use any particular device, but there are plenty of worse ways to use them. Keep it simple, repeatable and let your sense of taste have the ultimate say.

Instead of detailing how to use each preparation device, we're going to look at an example device and preparation method using each of the brewing methods. I'd like you to experiment with your chosen preparation method by changing one variable at a time and deciding for yourself how best to brew. This process of testing and adjusting is something that I want you to get into the habit of doing. It's the only way we improve our coffee making.

Three phases of brewing

With gas expansion, fluid dynamics and the chemistry of extraction all at work together, the brewing system is complex. Adding to this complexity, we also have different brewing methods that result in a difference in the way these systems interact. To give some practical examples, we'll look at three phases of brewing for each of the three main brewing methods.

1. Initial water contact

Hot water washes over the ground coffee, displacing the gases around the grinds, pushing the finer grinds to the bottom of the slurry. The hot water causes expansion of the remaining CO_2 in the coffee and the CO_2 gas escapes.

During this initial stage, the bubbling CO_2 forms a bloom of gas and coffee grounds (see Figure 1.11), pushing some grounds out of the slurry and preventing even wetting of the grounds. After 20–30 seconds, most of the CO_2 will have left the beans and either a stir or a pouring of more water will allow the trapped CO_2 to escape into the atmosphere and return the errant grinds to the slurry.

Keep any stirring to a minimum to make the action more easily repeatable.

Figure 1.11 Initial water contact

2. Extraction

The ground coffee absorbs the water and the water pulls chemical compounds out of the grinds and dissolves coffee solids. Consistency is important. If your method involves any intervention, such as pouring or stirring (Figure 1.12) then make sure that you do this at the same time and for the same duration each time you brew.

Figure 1.12 Extraction

To make things easily repeatable, pour the same amount each time and at obvious intervals, rather than coming up with complicated routines involving time, volume and calculus on the fly.

3. Drawdown

The drawdown phase is the final draining of the brew water through the grinds for some preparation devices. The rate is often slow and inconsistent at the drawdown phase due to fines blockage and the lessening weight of the water pushing through (Figure 1.13). At this stage, most of the extraction has already taken place and we're intervening to prevent inconsistent contact time.

Give the slurry a quick '**Scott Rao**' stir immediately before drawdown to reduce the likelihood of blockages for the last of the water.

Figure 1.13 Drawdown

Brewing methods: in detail

Categorising the preparation devices into three brewing methods is useful as the brewing method determines much of how we manipulate the flavour of the coffee. Be aware that some preparation devices may be used to brew using different brewing methods. I've categorised them according to their most common preparation method.

In the next pages, we will look at the phases of brewing – initial contact, extraction, drawdown – for examples of (1) immersion, (2) drip and (3) pressure brewing methods.

Immersion

Camp coffee, ibrik, cafetière, aeropress, trifecta, steampunk, syphon, clever dripper, cupping, filter bag

Coffee Brew Ratio: 1:13.3

Initial water contact. Heat the syphon brewer until the water in the upper chamber reaches the desired temperature and then add the coffee. Generally, it's better to add your coffee to the water in immersion brewing.

Give the slurry a limited, repeatable stir to collapse the **bloom** and ensure that all grounds are soaked.

Extraction. One advantage of the immersion method is that all the grounds are suspended in the liquid, making it easier to get an even extraction. We can change the amount of extraction by varying the contact time, grind size, or turbulence. The easiest and most repeatable method to change the extraction is to change the contact time.

If you're concerned to get the most out of your coffee, you can dose less and brew twice using less water initially and the rest of the water on a second draw (for simplicity, I don't recommend this).

Drawdown. Some devices have a drawdown phase.

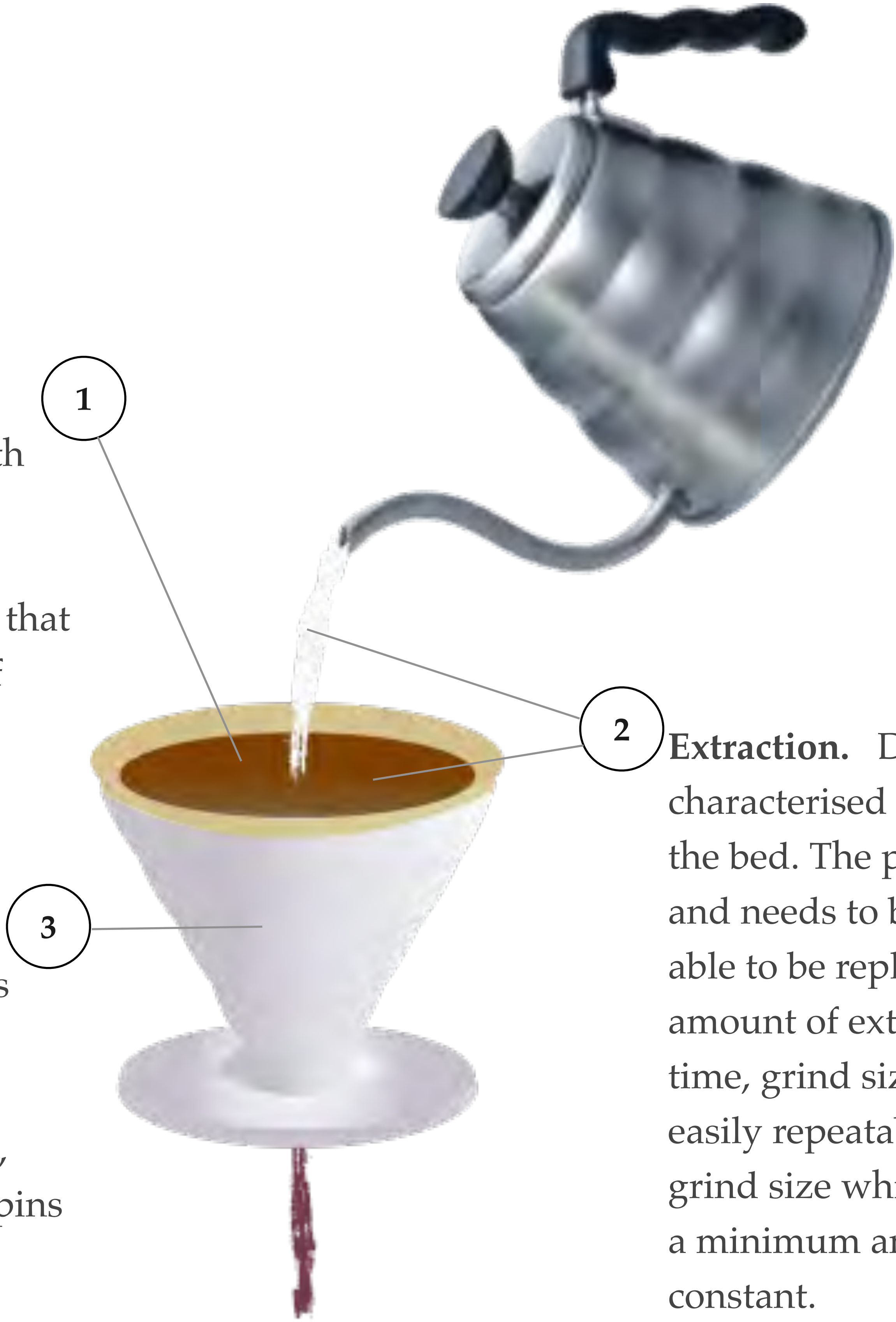
Some baristas like to give the **slurry** a stir at the beginning of the drawdown phase to encourage a more consistent extraction.

The three phases of immersion brewing

Drip

v60, automatic drip, mellita cone, chemex, phoenix, ice drip

Coffee Brew Ratio: 1:16.7



Initial water contact. Preinfuse with enough water to ensure that all the grinds are wet. Limited, consistent stirring during **preinfusion** ensures that all the grinds are wet and gets rid of excess CO_2.

Extraction. Drip methods are characterised by water pouring through the bed. The pouring action is turbulent and needs to be even across the bed and able to be replicated. We can change the amount of extraction by varying the pour time, grind size and turbulence. The most easily repeatable method is to change the grind size while keeping the turbulence to a minimum and the pour of water constant.

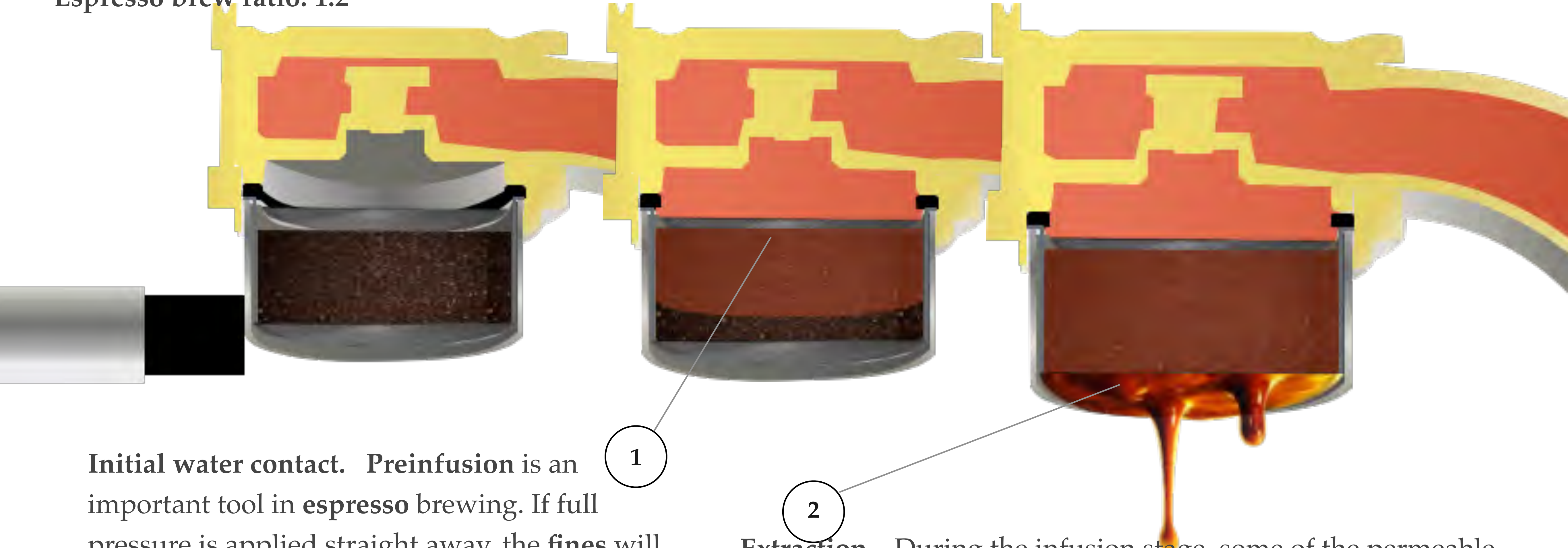
Drawdown. Extraction lessens throughout the pour. What's important here is consistency. Unless you religiously repeat it, don't attempt **Scott Rao** style spins for drip.

The three phases of drip brewing

Pressure

Espresso

Espresso brew ratio: 1:2



Initial water contact. **Preinfusion** is an important tool in **espresso** brewing. If full pressure is applied straight away, the **fines** will quickly migrate to the bottom where they may form a restrictive plug. A preinfusion also gives more time for extraction from the **permeable grinds** before some are pushed out of the basket during the **infusion** stage.

Extraction. During the infusion stage, some of the permeable grinds flow through the filter basket holes and their extraction rate is greatly reduced. The larger grinds remain behind and are extracted under pressure for the duration of the water pour. Three ways to change the amount of extraction are by changing the grind size, increasing the preinfusion time, or pouring more water through the puck. The easiest change is adjusting the preinfusion time or grind size. For more on this, see Chapter 5: Espresso.

The two phases of pressure brewing

Cold coffee

Most coffee is brewed using hot water but coffee brewed over many hours at low temperatures has burgeoned beyond trendy and into a flourishing industry. This type of coffee is easier to brew and can be made in large batches.

Cold brew coffee

Coffee can be brewed at room temperature or chilled for 8–12 hours to give an interesting, full-flavoured brew. Brew ratios are typically higher for cold brew and vary between 1:3 to 1:12. Cold brew coffee usually involves immersion brewing but it plays by different rules, due to reduced temperatures and extended time.

Nitrogenated coffee

Cold brewed coffee can be infused with N_2 or an N_2/CO_2 gas mix to make nitrogenated coffee that is similar in appearance to stout beer. These coffees can be stored in kegs and put through the same draft system as stout.

The faucet for stout has a restrictor disk that causes the gas to foam up giving the characteristic cascading microbubbles commonly found in stout.

Nitrogenated coffee can be pure coffee, estate coffee or blend coffee, and can be prepared from a mix of espresso, cold brew or vacuum prepared coffee.

Nitrogenated coffee from the Stone Cold Brewing Company.

Brewing tips

Here are some tips on how to get better control of your brewing techniques:

Measure your ingredients precisely. Use a digital scale, accurate to 0.1 g. You will not be able to get repeatedly good coffee through using the force alone, young Anakin. Good coffee comes from disciplined precision ... and decent beard growth.

Ensure the coffee isn't stale. Filter coffee tends to be at its best within four weeks if vacuum packed, and one week if not. Grind the coffee just before you add it to the water. This ensures that we have the same amount of CO_2 from brew to brew.

Experiment with grind size. Different preparation devices call for set grind sizes, but don't be afraid to experiment. Changing the grind size is the best way to vary extraction in drip and pressure brewing.

Experiment with contact time. Varying contact time is the easiest way to trace the path between under- and overextracted coffee, and it is the most consistent way to change extraction in immersion brewing. Contact time varies from 25 seconds (for espresso) to 12 hours (for ice-drip coffee). Always use a timer.

Experiment with turbulence. Agitation or stirring both mixes your slurry to make the extraction more even, and speeds up the rate of extraction.

Experiment with coffee to water ratios. Start with a coffee brew ratio of 1:16.7 for drip brewing and 1:13.3 for immersion brewing. Change the ratio to change the strength of the coffee without changing the extraction. The 'right' brewing ratio will depend on the coffee, the preparation method and your own personal preference.

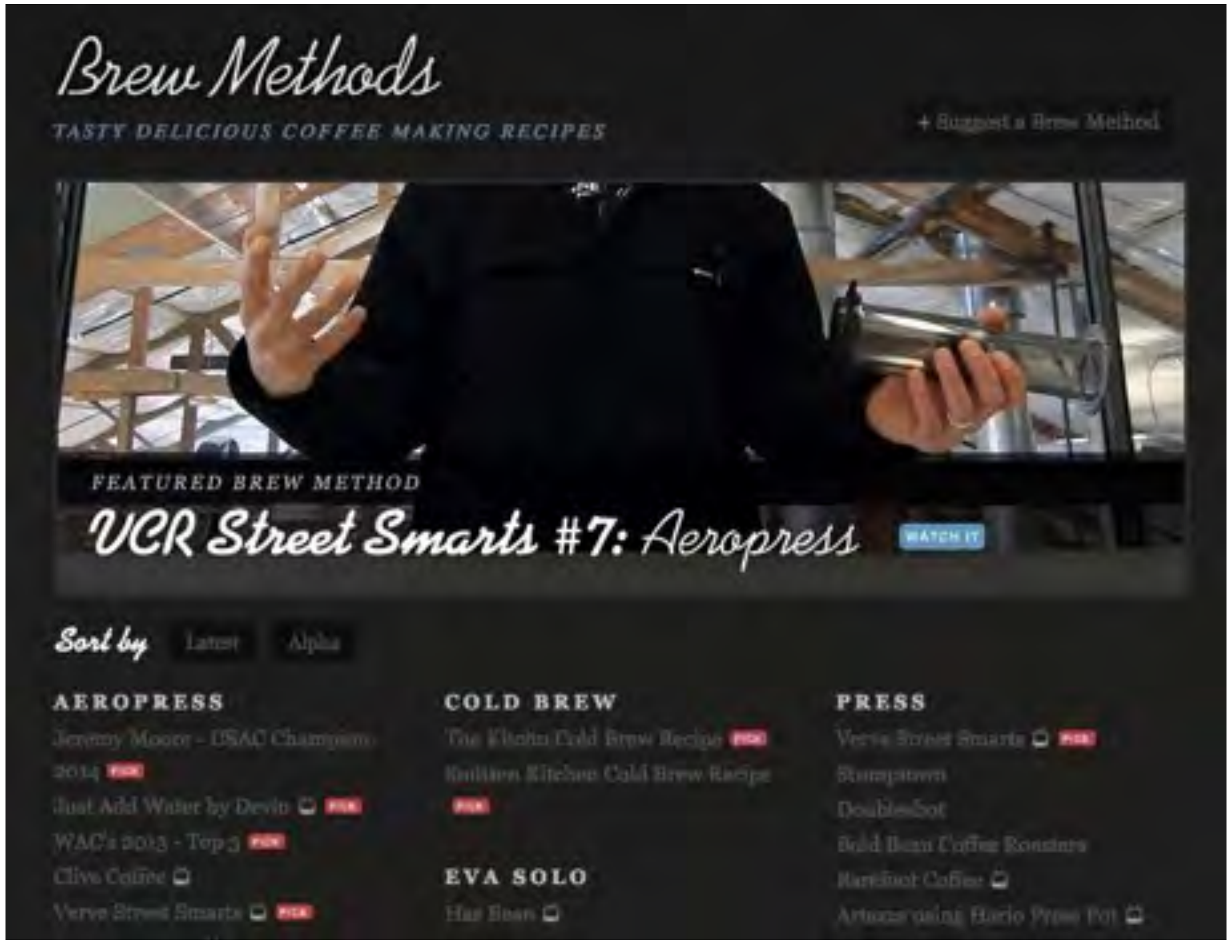
Use good quality water. See Chapter 2: Water.

Keep temperature consistent. The temperature of your water plays a huge role in extraction rate.

Clean your brewing equipment after every brew. Coffee made in dirty equipment gives undesirable flavours.

Read, experiment and become an expert in coffee ... but don't be a dick about it. Sometimes you can get great coffee by doing the wrong thing, too. The resulting cup of coffee is all that matters.

To see how other clever people brew their beverages, have a look at BrewMethods.com. Have a go at a few methods on the site and see which of them you prefer.



Much about brewing coffee is the necessity to keep things consistent and the ability to play with the variables that can change flavours. Those pesky variables and how they change our flavours is what the next section is all about.

1.3 Key learning points

1. When brewing, focus on the flavours and the potential repeatability of the process.
2. Brewing has three phases: initial, extraction, and drawdown.
3. There are three main brewing methods: immersion, drip, and pressure.
4. Brewing tips:
   a) Measure your ingredients precisely
   b) Use fresh coffee
   c) Experiment with:
      i. Grind size
      ii. Contact time
      iii. Turbulence
      iv. Coffee/water ratio
   d) Use quality water
   e) Measure your water temperature to ensure it is consistent
   f) Clean your brewing equipment

Review of Brewing Methods

Question 1

What two things should we concentrate on when we are brewing? (One answer)

A. TDS
B. Flavour and repeatability
C. Cleanliness and extraction
D. Grind size and dose

Question 2

What method of brewing does a cafetière use?

A. Immersion
B. Drip
C. Pressure

Question 3

Which of the following preparation methods use the pressure brewing method?

A. French press
B. Steampunk
C. Espresso
D. Aeropress

Question 4

Which of the following are the three brewing phases? (One answer)

A. Phase 1, Phase 2, Phase 3
B. Immersion, drip, pressure
C. Initial, extraction, drawdown
D. Bloom, brew, filter

Review 1.3 Answers

Question 1

Correct answer: B

Question 2

Correct answer: A

Question 3

Correct answer: C

Question 4

Correct answer: C

Manipulating the Flavour

Photo by Lukasz Gasiorowski

The flavour of strength

There are two ways that we can make a coffee stronger: **increase the brew ratio** or **extract more**. We need to be able to identify each by taste before we busy ourselves with changing variables in our preparation methods.

Before we look at the complexities of manipulating the flavours that we're extracting, we're going to do two exercises: (1) to separate the taste of strength that comes from brew ratio and (2) to assess the taste of strength that comes from extraction.

The flavours of low and high brew ratios

Concentration affects our perception of flavour. Try a short black and a long black side-by-side. The short black is highly concentrated, powerful and it is difficult to distinguish more than a few intense flavours. The long black is weaker, comforting and has many subtle flavours.

Which is better? That's subjective. Some people prefer the intensity of the short black, others prefer the subtlety of a long black.

Exercise: tasting the brew ratio

Changing strength by brew ratio is very easy to do: we either change the amount of coffee or the amount of water.

Tools

Kettle
3 Clever Coffee Dripper brewers
3 filter papers
3 takeaway cups
3 coffee cups
Pens
Timer
42 g coffee bean (known to have some acidity)
Grinder
Measuring scales (accurate to 01. g)
800 mL brewing water

Method

1. Fill your kettle with 800 mL of water and bring to the boil. Fold 3 filter papers and place 1 into each of the 3 brewers. Wash out the filter papers with boiled water.
2. Write ‘8 g’ on the first takeaway cup, ‘14 g’ on the second and ‘20 g’ on the third. Line the takeaway cups up and place a coffee cup in front of each to receive the brew.
3. Grind 8 g, 14 g and 20 g of coffee separately, all on a coarse setting and into the respective takeaway cups.
4. Place the first brewer on the measuring scales and then pour in 200 g water (just off the boil). Repeat the process for the other 2 brewers. Place each brewer in front of a coffee cup.
5. Start your timer and quickly add the ground coffee to each of the brewers, stirring each of them just once. Place the lids on the 3 brewers.
6. After 2 m 30 s, remove the lids from the brewers, give the coffee within each a quick stir and place the brewers on top of the relevant coffee cup to release the brew. (N.B. If the drawdown takes longer than 40 seconds, you may have ground either too finely or stirred too much.)
7. Wait for another 4 minutes before tasting.

Tasting

Taste each of the coffees and think about how they taste in comparison to one another. The 8 g coffee cup contains a brew ratio of 1:25. The 14 g coffee cup contains a ratio of 1:14.3 and the 20 g coffee cup contains a ratio of 1:10. You’ve got the full gamut of the coffee world’s preferences right there in front of you. The question is, what's your preference?

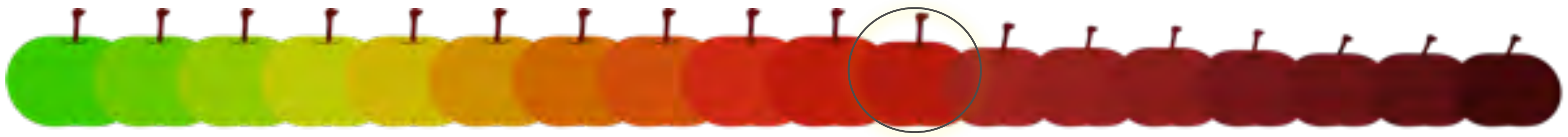
If you don’t have clever drippers, cafetières work just as well. Just increase the brew time to 4 minutes.

Once you've found a brew ratio that you like, stick to it and manipulate the variables allowed by the preparation device to change what you're extracting.

But, before that, let's taste extraction.

The flavours of underextraction and overextraction

Remember our apples and how we wanted to get the tastiest, sweetest ripest apple possible? It's not easy to guess the best time to eat the apple. How do we know that if we hadn't waited another day it might have tasted yet sweeter? Take a box of apples out of the fridge and eat one a day for 5 days. With each passing day, the apple will be sweeter, and your enjoyment will likely increase ... until the day you bite in and become faintly aware that some mould has been enjoying it some time before you have. You now know that you should have eaten the rest of the apples the day before.



Just like a good Peasgood's Nonsuch, we're looking for the sweetest coffee we can get. We need to be able to recognise whether coffee has been under- or overextracted; the best way to do this is to drink lots of coffee that has been extracted to different levels. In brief:

Underextracted coffee tastes sour, astringent, pithy and thin with a quick finish.

A **well-extracted** coffee has enough sweetness to turn the sourness into delicate acidity and the pithy, astringent flavours into warm, enjoyable ones that you can still taste long after taking the first sip.

In an **overextracted** coffee, the flavours that tasted great a moment ago quickly become overwhelmed by ashy, harsh, bitter compounds. It is bitter, dry and has an unpleasant finish.

Exercise: tasting the extraction

Being able to taste the difference between underextracted and overextracted coffee is as fundamental to being a barista as... echolocation is to being a fat bat. Without this skill, you will be forever trapped in the dark cave of sour sips and bitter brews.

Tools

Kettle
4 filter papers
4 Clever Coffee Dripper brewers
60 g coffee beans known to have some acidity
Grinder
Scales (accurate to 0.1 g)
4 takeaway cups
4 coffee cups
Timer
1 litre brewing water
Refractometer (nice to have; not essential)

Method

1. Fold your filter papers and place into the four brewers. Wash out the filter papers with boiled brewing water.

2. Write ‘1 m’ on the first takeaway cup, ‘2 m’ on the second, ‘3 m’ on the third and '4 m' on the fourth takeaway cup. Line the takeaway cups up and place a coffee cup in front of each to receive the brew.

3. Fill the kettle with 1 L water and start to boil. Grind 15 g of coffee at a coarse setting into each of the 4 takeaway cups.

4. Using the scales, pour 200 g water just off the boil into each of the brewers.
5. Start your timer, quickly add the ground coffee to each of the brewers and stir once. Place the lids on the brewers.
6. After 1 minute, remove the lid from the first brewer, give it 1 stir and place on top of the appropriate coffee cup to release the brew. Repeat the process for the other brewers at the 2 m, 3 m and 4 m marks. (N.B. If the **drawdown** takes longer than 40 seconds, you may have ground too finely or stirred too much.)
7. Wait for another 4 minutes before tasting.

Tasting

Taste each of the coffees and think about where they sit on the **extraction spectrum**. The shortest brew time should be quite sour and weak. The longest brew time should be quite bitter and dry.

The brews in between should be closer to our ideal extraction. Identify which is the closer to ideal extraction by noting the one with greater sweetness, less sourness and more fruity, less bitterness and greater body with a pleasant finish.

Testing

If you have a refractometer, test each of the coffees for percentage extraction. We’re looking for extraction percentages of below 18 and above 22 in our spread. If the percentages are too low, increase the time of extraction. If they are too high, decrease the time of extraction.

If you don’t have Clever Drippers, cafetières work just as well. Just change the timings to 2 m, 3 m 30 s, 5 m and 6 m 30 s (however, you will need to run the coffees through a filter before testing with the refractometer).

Flavour manipulation for immersion and drip brewing

Coffee-making is a little like baking a cake. When we brew our coffee, we start off with our ingredients and use a set preparation method. When we change the variables in our preparation method, we can get wildly different tasting brews. Let's start with our ingredients – the brew ratio – and a basic preparation method.

Basic coffee recipe

Tools

Coffee	1 part
Hot water	13 parts for immersion brewing or 17 parts for drip brewing

Method

1. Grind the coffee coarsely.
2. Start your timer and add the water. Stir.
3. Once the coffee is well extracted, remove the grinds from the water.

This method makes a decent coffee for any number of people.

Changing variables

Because our coffee beans are always changing as they age, we can't rely on this recipe alone. Like good bakers, we need to taste our product and understand what variables we can use to enhance the flavour of the coffee. When we decide that we want to change the taste of our brew, we change one variable and prepare everything else in exactly the same way. We then taste the coffee again to see how this change has affected the brew. To prepare the brew exactly the same way each time, we need to obsessively measure and record variables such as weights, temperatures, volumes and times – just as a scientist does in his lab (but using much better coffee).

Primary flavour manipulation

Immersion brewing

Brew your basic coffee recipe. Taste it.

Your immersion brews are likely tasting pretty good right now. If not, we can change the grind size or the contact time to adjust the extraction. The easiest variable to change is the **contact time**: increase the time to increase extraction, and decrease the time to decrease extraction.

Drip brewing

For drip brewing, brewing after using the basic coffee recipe will likely make your coffee taste sour and thin (underextracted). We can increase the extraction by grinding more finely.

Keep the brew ratio the same, grind more finely and brew again. Repeat this process until the brew is bitter. Then grind one step coarser. You now have a specific coffee recipe.

Once you've done this for a few coffees, and are good at judging whether the coffee is under- or overextracted, I suggest you speed up the process by bracketing the grind size (see Video 1.10). Bracketing is the quickest way to zero-in on your target the next time you're launching a mortar attack.

Video 1.10 Primary flavour manipulation for drip brewing

Your first shot is give your best guess at the distance between you and the target. Say you're just short of it first time round; the second shot should be taken a few steps closer. If it still falls short, well you've still saved yourself several shots. If you find yourself too far off the mark, then at least you've worked out the range and you now know to pull back a bit.

The same thing applies for your coffee. Just keep firing and tasting the result until you get yourself on target.

You're probably tasting half-decent coffee by now. To strike on that elusive excellent coffee, you need to work on developing your palate.

Secondary flavour manipulation

At a basic level, we're looking for a balance of sour and bitter, and as much sweetness as possible. However, remember that we're dealing here with single origin coffee. Each coffee has its own particular flavour compounds and tactile idiosyncrasies that make it unique. We have to really *taste* the coffee to comprehend what it is that we want to get out of it.

It's often the case that you'll catch a hint of something delicious on which you'd like to concentrate, or alternatively a waft of something unpleasant that you'd prefer to leave in the grinds. The ability not only to sense these flavours but also to hunt them down is what separates the master coffee stalker from the cowboys.

To be able to make the necessary adjustments for getting the best flavour out of coffee, you need to be able to:

1. Discern what is nice and what isn't (flavour, texture), and

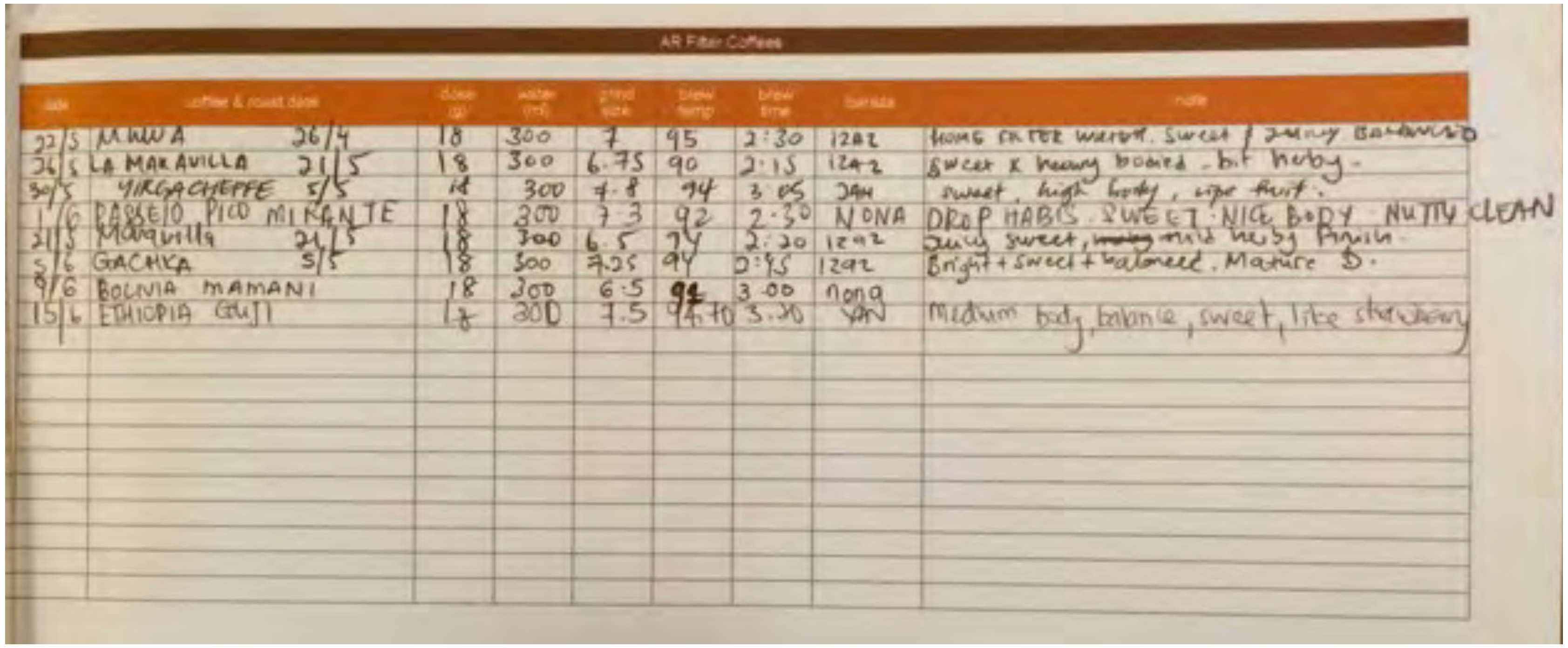
2. Understand the likely effects that occur when each of the variables are manipulated.

Serious baristas and coffee obsessives will repeatedly brew coffee, changing one variable at a time until they eventually find a taste that they're happy with.

The recipe that we're happy with becomes the 'specific coffee recipe' and should be written on a card, like Figure 1.14, for every coffee served on your premises. Information on this card should include:

- Dose
- Water
- Grind size
- Agitation
- Temperature
- Timings
- ...and any other information necessary to repeat the brew.

Figure 1.14 Example of a specific coffee recipe card



The following pages re-examine the variables for immersion and drip brewing that we already looked into in the Thinking About the Brew section. Here, we'll look at precisely how we can use them to manipulate the flavour.

There are many variables that affect flavour but the ones that we largely use in practice to change our brew are grind size, contact time, turbulence and brew ratio.

Photo by Tim Wendelboe

Noma coffee preparation with a refractometer.

... by grind size

Surface area

Coffee beans are delicious little taste parcels. We grind the beans to access the flavours that are stored inside them. When we grind our coffee beans, we increase the surface area of the bean, so exposing new surfaces and fragile flavour compounds to our boiled water. The smaller the grind size, the greater the surface area and the faster the extraction will be.

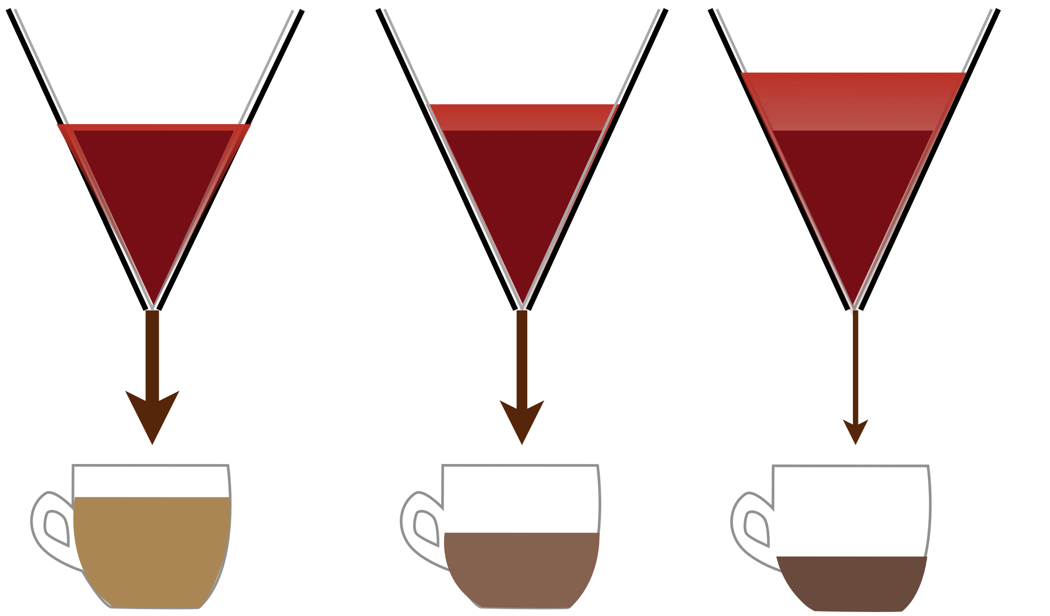
But surface area is not the only variable that is affected when you change the grind size:

Flowrate and contact time

Grinding finer slows down the rate of the flow of water through the coffee bed in drip and pressure brewing (see Figure 1.15). At the same brew ratio, water has a greater contact time with finer ground coffee. This, along with the increase in surface area, leads to greater extraction.

Conversely, if we use a coarser grind, we speed up the rate of water passing through the grinds and decrease the contact time for a given volume of water. Flowrate adds another level of complication to the drip and pressure brewing methods.

Figure 1.15 The effect of grinding finer on the flowrate



Coarse grind on the left, fine grind on the right.

Fines

The finer we grind, the more fines we produce. This leads to greater extraction from the fines in our cup, skewing our average extraction. That doesn't mean we should avoid finely ground coffee altogether: too coarse and the water will only wash over the outside of the grinds, extracting from the surface but missing out on much of the flavour inside. There's a balance between the ratio of fines to modal grinds that's ideal and it's your job to find it. Just like cracking open a safe, you have to keep trying all the combinations until you get the right one.

Flavour

Generally speaking, grinding coarser will move the taste balance from bitter through sweet to sour and a greater clarity in the coffee. As we grind finer, the taste balance moves from sour, to sweet, to bitter and we get to fatter mouthfeel and more complex flavours.

Non-proportional change

We'll see in Chapter 3: Grinding that changing the grind size does not result in a proportional change in flavour.

Limiting your offer

Ever been disappointed by a friendly barista who offered to make you any coffee you liked using your choice of coffee brewer? Often. It's essential to have worked out the best grind size and specific coffee recipe for every coffee and coffee brewer you have on offer. Don't offer a choice of *any* of the six coffees available using *any device* ... unless you've worked out the specific coffee recipe for all 18 of these combinations. It's better to offer only one coffee, and to make sure that it's a great one.

... by contact time

Contact time and extraction are directly related: the longer the contact time, the greater the extraction.

A nice bloke called Ted R. Lingle, author of *The Coffee Brewing Handbook*, once sat down with a lot of coffee, a timer and presumably some beta-blockers to categorise the flavour compounds in coffee by molecular weight. The smallest molecules extract first and the largest molecules extract later, and he found that they extract in the order of fruit acids, light caramels, dark caramels, Maillard and dry distillates. These are shown in Figure 1.16 (I added another category for the initial aromas). We can test Lingle's findings for ourselves by using a drip brewer, splitting the pour into 10 cups and tasting the coffee in the order it came out.

Although this might seem to make the task of coffee brewing too easy, the process of extraction is complicated by the different sizes of grinds, ratio of fines present (dependent on our grinder and grind size), flowrate, turbulence, water temperature, and by whatever is in the beans to start with (dependent on the grower, shipping, roaster and storage).

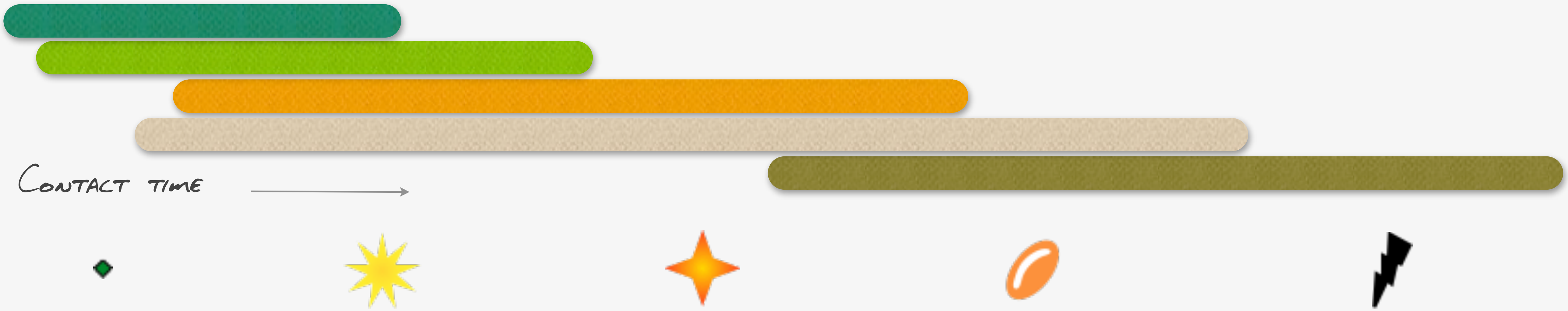
Extraction

We're trying to get as much good stuff out of coffee grinds as possible without too much of the bad stuff coming out and fouling up our brew. As the water extracts flavour from the beans, we run through flavours and textures from sour and thin, through sweet with lilting fruity acidity and round mouthfeel, to bitter and dry with an unpleasant finish. This is called the flavour or extraction spectrum.

There is nothing wrong with a bit of bitterness. Some of my favourite things – olives, porter beers, *yerba mate* – are bitter, but they all contain a medley of other flavours that make the overall flavour not entirely bitter. The best coffee is one that is sweet but that contains other interesting aromas.

Changing the surface area of the coffee by changing the grind size is the quickest way to alter the extraction rate. Using contact time is the simplest way to control extraction: it's like waiting for that apple from the previous example to ripen. Using an immersion brewing method, we can easily control the time that the water has been exposed to the grinds while still maintaining the brewing ratio. With drip and pressure brewing methods, we can extend the preinfusion time, slow down the pour (flowrate) manually or mechanically, or use the grind size to change the speed of the pour.

Figure 1.16 Ted Lingle's categorisation of flavour compounds by molecular weight



Initial aromas: these are the fruity, floral, herby aromas. They are present from the first drop and are stored in the coffee lipids.

Fruit acids: these are acidic with citrus, tropical, and stone fruit aromas. They taste bright and crisp in sweeter brews, and sour in less sweet ones. They dissolve very quickly.

Caramels: light caramels are very sweet and are followed by dark caramels, which are bitter-sweet.

You should be trying to extract as many of these caramel flavours as possible.

Malliard: these are bready, woody, tannic, or nutty. Warm and comforting in sweeter brews; astringent in less sweet brews. They dissolve slower than the fruit acids but will be present in all brews.

Dry distillate: these are carbonic, spicy, and turpene. They are bluntly bitter and ashy in less sweet brews and have a bitter-sweet molasses taste in sweeter brews. They can be extracted early on, but are mostly extracted very late in the process. Prominent in dark roasts.

Adapted from Some Aspects of Espresso Extraction *by Jim Schulman, Feb 2007.*

... by turbulence

Turbulent extraction extracts faster than still extraction. If your brewing method allows for agitation or varied pouring, you can use these to speed up extraction. Record the time and duration of any pour or stir and repeat them for consistency between brews.

... by brew ratio

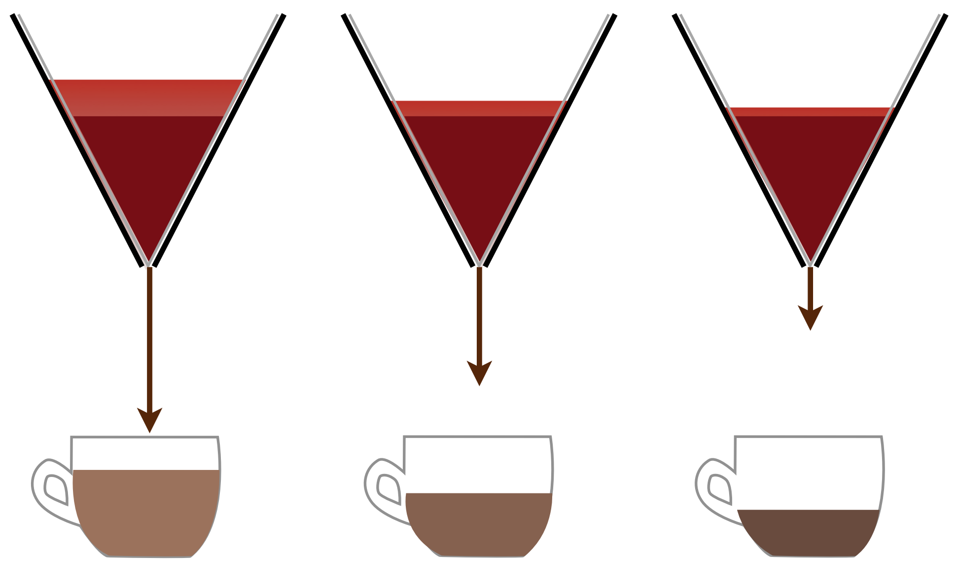
We change the brew ratio to change the strength of the coffee. To change the brew ratio, we either add or subtract coffee or water.

We started with a basic coffee recipe that was based on 6 g / 100 mL or 1:16.7 for drip, and 7.5 g / 100 mL or 1:13.3 for immersion. While this might be a good place to start, it shouldn't be engraved on your coffee bench. Different preparation methods or coffees might work better with different brew ratios. Changing the amount of brew water is preferable to changing dose because once we change the dose, we start over and once again have to experiment with grind size, contact time and turbulence.

If you use less brew water with the same dose and grind size, you will increase the mouthfeel and concentration (see Figure 1.17). With the drip brewing method, using less water means you'll also extract less, taking the brew more towards the sour end of the spectrum.

I encourage you to experiment with the brew ratio and feel free to start with a different dose, but once you've worked out a good recipe, work with it. Keep your recipe the same and manipulate

Figure 1.17 Changing brew ratio using water



Increasing the brew ratio and concentration from left to right.

the flavour using the grind size, contact time, turbulence and brew water before changing the dose again. That should be the last variable you change.

Recommended workflow by brewing method

Each preparation method has its own little idiosyncrasies and I prefer not be too dogmatic concerning which variables to change because this will only stifle experimentation. However, as a rough guide, here are my secondary flavour manipulation recommendations for the immersion and drip brewing methods. The pressure method involves a few more considerations which we'll look at in depth in Chapter 5: Espresso.

Immersion

Immersion is the simplest brewing method because the yield doesn't change. Keep the grind coarse, the brew ratio at 1:13.3, pour in the water, add the coffee, and give the whole thing a stir. The extraction increases over time (Figure 1.18); all we need do is time the brewing process and remove the brew from the grinds at the right time.

If we want to manipulate the extraction further, we can introduce turbulence. If this doesn't work, then we can change the grind size. Lastly, change the brew ratio only if you wish to change the concentration. The adjustment order is shown in Figure 1.19.

Figure 1.18 Immersion extraction

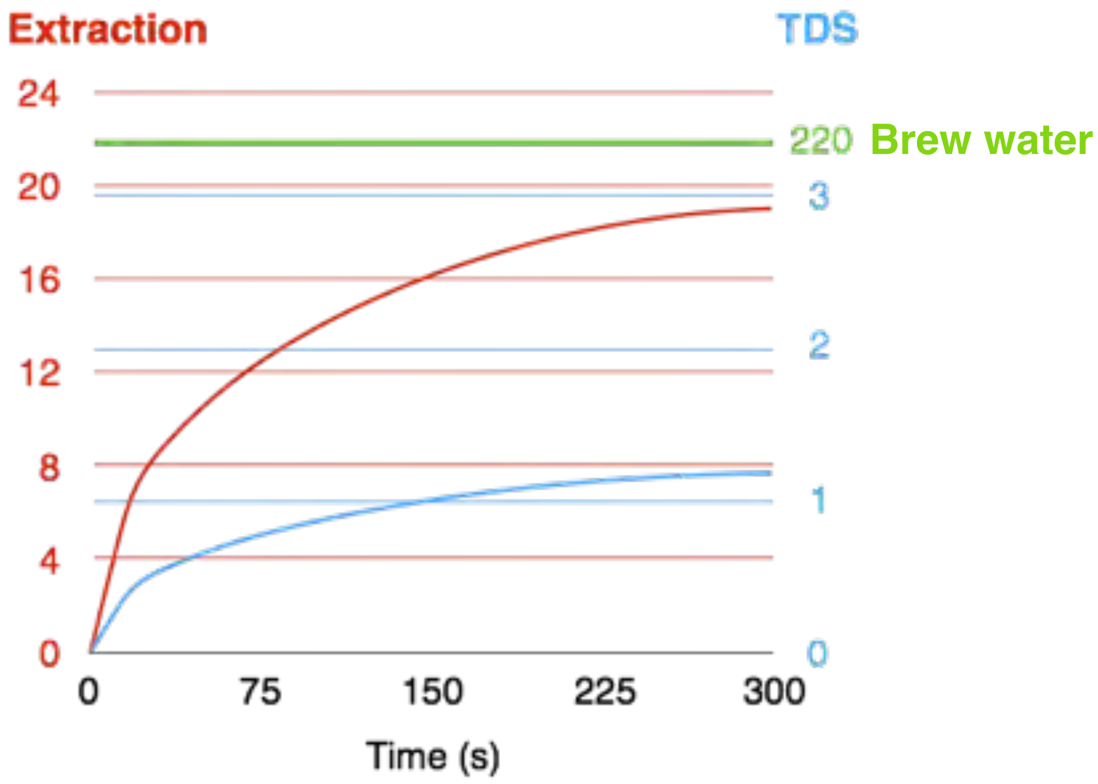


Figure 1.19 Adjustment order for immersion brewing

1. Contact time
2. Turbulence
3. Grind size
4. Brew ratio

Drip

It is much more difficult to get consistent extraction from drip coffee than it is from immersion. Use finer grinds, a brew ratio of 1:16.7, pre-infuse with a stir, and pour evenly to wet all of the grinds. Taste the result, then adjust the grind size and try again. If that doesn't get you the result you want, vary the amount of brew water. Both of these variables will change your extraction, but changing the amount of brew water also changes your volume. Avoid changing your pour rate because it's less consistent than changing grind size (Video 1.11). Varying the preinfusion time is a good way to vary contact time without changing the grind size. The adjustment order is shown in Figure 1.20.

Video 1.11 Changing the grind size in drip coffee

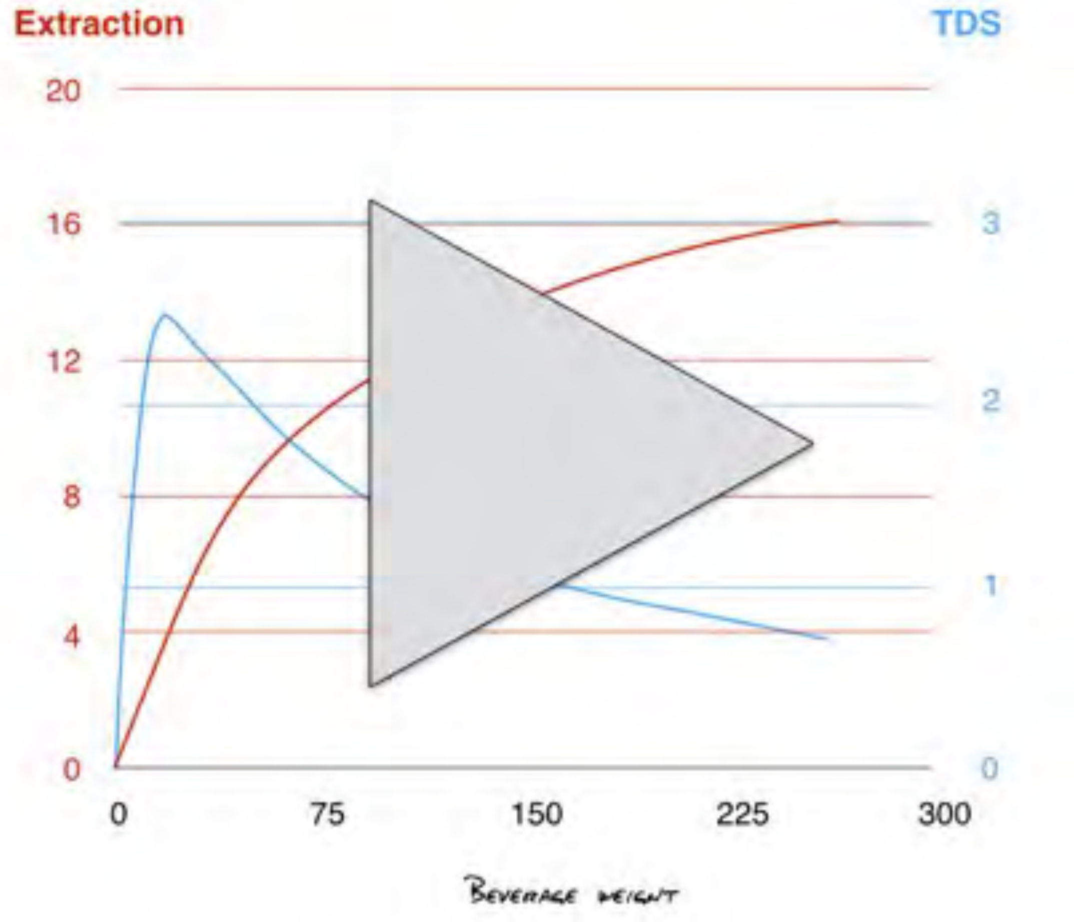


Figure 1.20 Adjustment order for drip brewing

Adjustment order:
1. Grind size
2. Brew Water
3. Preinfusion time
4. Turbulence
5. Pour rate
6. Dose

Pressure

Espresso machines are highly engineered, giving us great control over the temperature, flowrate and volume of extraction.

The difficulty is that it all happens so fast and at a great pressure.

Use a dose based on the basket that you're using. Start with a brew ratio of around 1:2. Preinfuse and get your contact time to around 30 seconds by changing your grind size while maintaining the dose.

Change the strength and extraction by pouring either a longer or shorter shot, which will change your yield (brew ratio) and contact time.

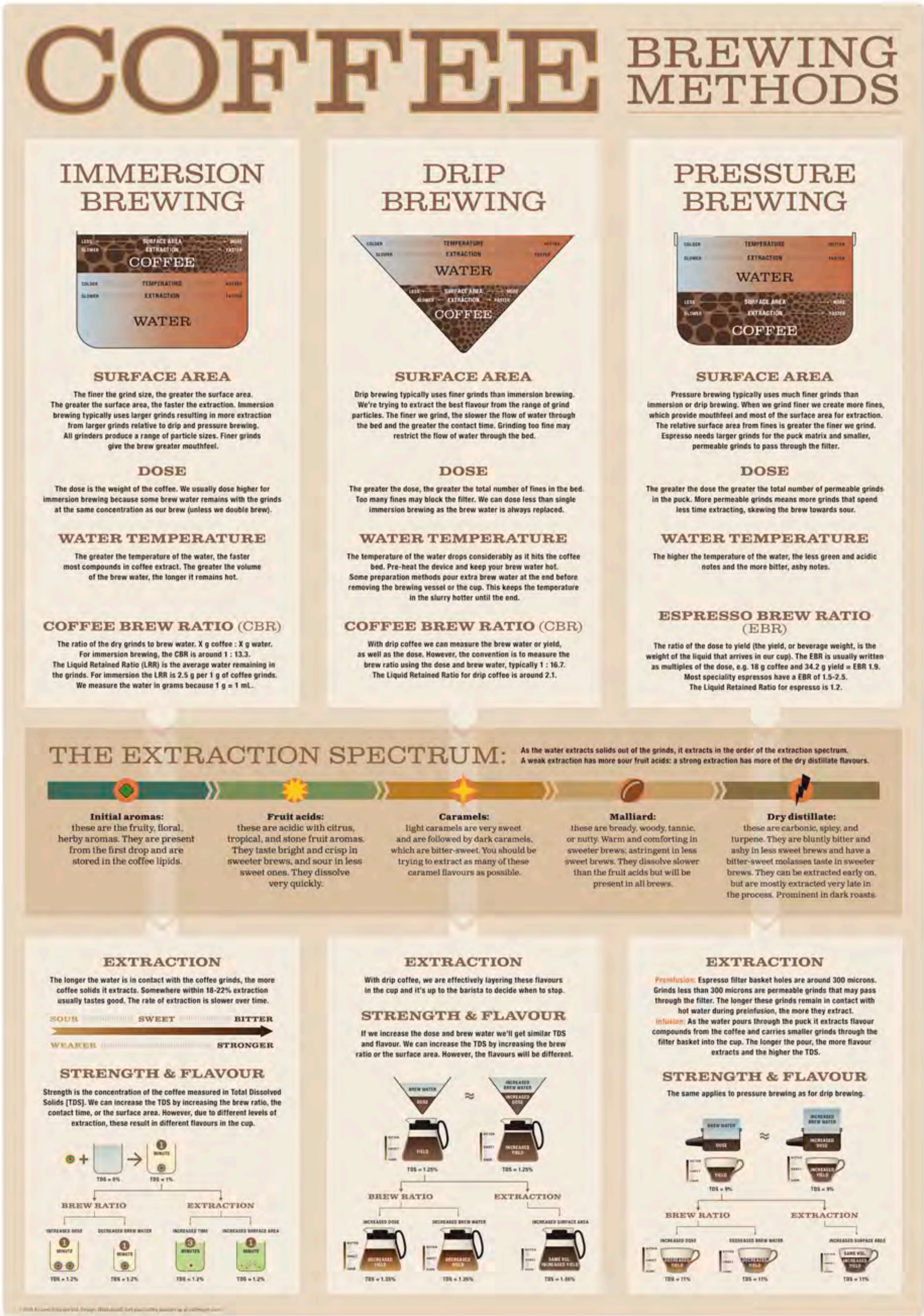
Change the strength and extraction by changing the preinfusion time, which changes the contact time, but not the yield.

Change the strength and extraction by changing the grind size, which, again, changes the contact time, but not the yield.

If that all seems a little rushed; don't worry. It's listed here in Figure 1.21 and we'll cover it again in Chapter 5: Espresso.

Figure 1.21 Adjustment order for pressure brewing

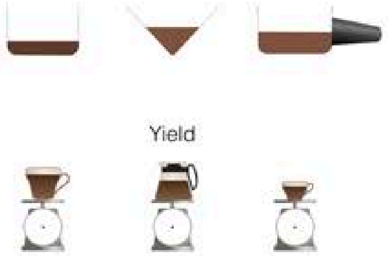
Figure 1.22 Coffee brewing methods summary



Video 1.3 Three Brewing Methods

Video 1.6 Temperature

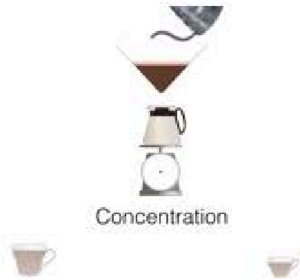
Video 1.9 Yield



Video 1.4 Surface Area

Video 1.7 Brew Ratio

Video 1.10 Concentration



Video 1.5 Dose

Video 1.8 Extraction

Video 1.11 Conc. and Flavour

Coffee and water are the ingredients of your brew. We've so far had a good look at 1.35% of the brew. It'd be a little uneven to ignore the rest. The following chapter is devoted to the 98.65% of a coffee, that is, water.

1.4 Key learning points

1. Start with your preferred brew ratio and a coarse grind.
2. For immersion brewing, vary the contact time to change the extraction.
3. For drip brewing, grind successively finer until the coffee becomes bitter, then take it one step coarser.
4. Underextracted coffee tastes sour, astringent and thin with little finish.
5. Well-extracted coffee is sweet, round with pleasant aromas and a long rich finish.
6. Overextracted coffee tastes bitter and dry with a horrible finish.

Review of Manipulating the Flavour

Question 1

What's a good brew ratio to start with? (Choose all that apply)

A. 1.25%

B. 18 - 22%

C. 1:13:3 for immersion brewing

D. 1:16.7 for drip brewing

Question 2

A smaller grind size will lead to: (Choose all that apply)

A. Greater surface area

B. Faster extraction

C. More sour coffee

D. Slower extraction

Question 3

What variable do we use for primary flavour manipulation in drip brewing?

A. Grind size

B. Dose

C. Brew ratio

D. Contact time

Question 4

An underextracted coffee will taste: (Choose all that apply)

A. Sour

B. Thin

C. Bitter

D. Dry

Question 5

An overextracted coffee will taste: (Choose all that apply)

A. Sour

B. Thin

C. Bitter

D. Dry

Question 6

Which variables do we use for secondary flavour manipulation? (Choose all that apply)

A. Grind size

B. Contact time

C. Turbulence

D. Brew ratio

E. Temperature

Question 7

If your coffee is too weak, how could you make it stronger? (Choose all that apply)

A. Increase the TDS by increasing dose
B. Extract more coffee
C. Use less water
D. Have a longer contact time

Question 8

Which of the following increase the rate of extraction? (Choose all that apply)

A. Grinding finer
B. Grinding coarser
C. Shorter contact time
D. Longer contact time
E. Still extraction
F. Turbulent extraction

Question 9

The extraction yield is: (Choose all that apply)

A. The amount of coffee extracted into the water
B. The percentage extraction
C. Important for handbrew only
D. Lowered by diluting with water after brewing

Question 10

"Generally speaking, grinding ______ will move the taste balance from ______ through sweet to sour and a greater ______ in the coffee." Choose the missing words below.

A. Finer
B. Coarser
C. Bitter
D. Sour
E. Complexity
F. Clarity

Question 11

As we grind ______ the taste balance moves from sour, to sweet, to ______ and we get fatter _______ and more ______ flavours.

A. Finer
B. Coarser
C. Bitter
D. Mouthfeel
E. Complex
F. Clear

Question 12

[As the contact time increases] "we run through flavours and textures from sour and ______, through ______ with lilting fruity acidity and round mouthfeel, to ______ and ______ with an unpleasant finish." Choose the missing words below.

A. Thick
B. Thin
C. Sweet
D. Bitter
E. Balanced
F. Dry

Question 13

The more turbulence, the faster the rate of _______. Choose the missing word below.

A. Spin
B. Grinding
C. Sourness
D. Extraction

Question 14

"If you use less brew water with the same dose and grind size, you will increase the ______ and _________. With the drip brewing method, using less water means you'll also extract ______, taking the brew more towards the sour end of the spectrum." Choose the missing words below.

A. Bitterness
B. Mouthfeel
C. Turbulence
D. Concentration
E. Slower
F. Less

Question 15

If my coffee is insipid, which of the following should I do? (Choose all that apply)

A. Agitate less
B. Make your grind size coarser
C. Maintain dose and extract more
D. Increase the dose and extract the same

Question 16

I brewed a drip coffee and the TDS is only 1.25%, yet the coffee is bitter. How could this be?

A. Not enough solids
B. Contact time too long
C. Too much water to coffee ratio, leading to an over extracted coffee
D. Grinds too coarse

Question 17

If my coffee is bitter, what is the likely cause?

A. TDS too high
B. Too much extraction
C. Too much coffee
D. Contact time too short

Question 18

If my coffee is overpoweringly strong, what is the probable issue?

A. TDS too high
B. Too much extraction
C. Too much brew water
D. Contact time too short

Review 1.4 Answers

Question 1

Correct answers: C & D

Question 2

Correct answers: A & B

Question 3

Correct answer: A

Question 4

Correct answers: A & B

Question 5

Correct answers: C & D

Question 6

Correct answers: A, B, C, D, E

Question 7

Correct answers: A, B, C, D

Question 8

Correct answers: A, D, F

Question 9

Correct answers: A & B

Question 10

Correct answer: B, C, F

Question 11

Correct answer: A, C, D, E

Question 12

Correct answers: B, C, D, F

Question 13

Correct answer: D

Question 14

Correct answers: B, D, F

Question 15

Correct answers: C, D

Question 16

Correct answer: C

Question 17

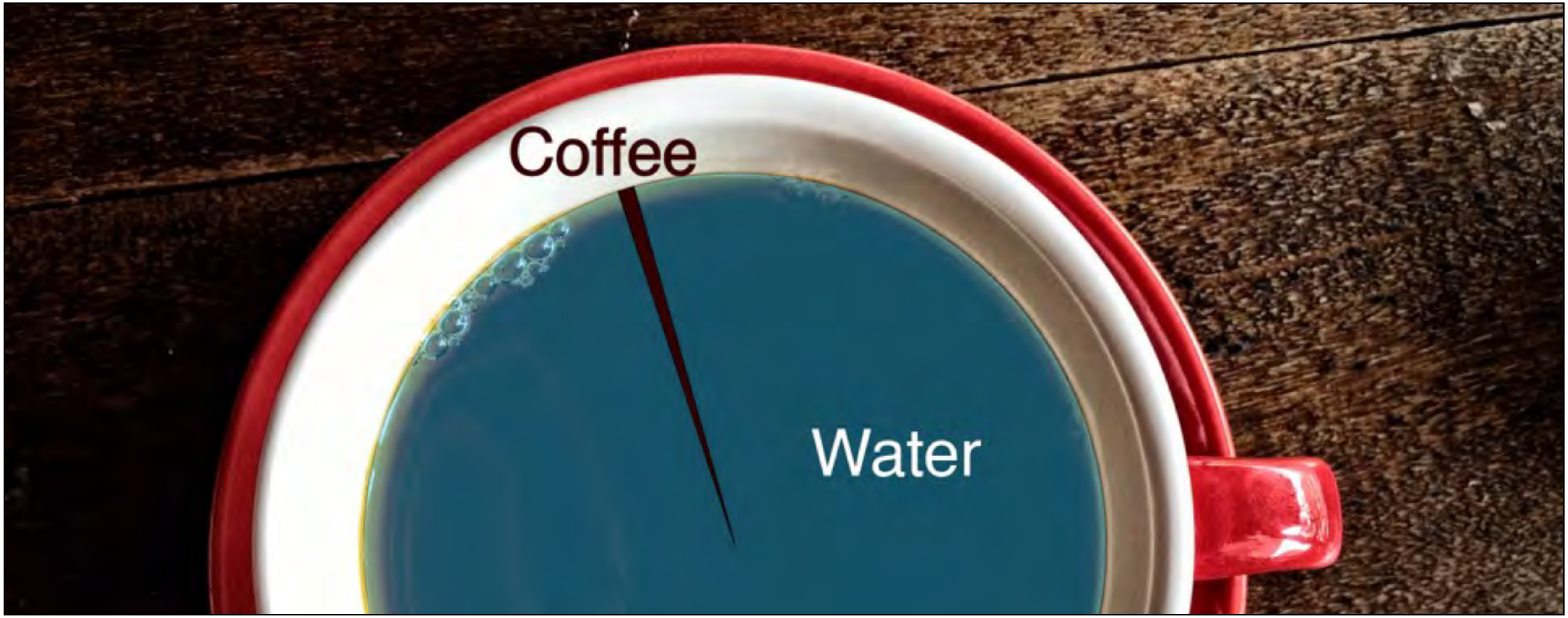
Correct answer: B

Question 18

Correct answer: A

Water

Calling our filter brew a cup of coffee is like calling South America the continent of Guyana. Presuming total dissolved solids are 1.25%, a coffee is 98.75% water. There's a lot more to a cup of coffee than coffee.



Water for Coffee

Water for Pilsener

Jump on to any homebrew forum on the internet and you'll find men with greyer and more fantastical moustaches than the most fashion-conscious baristas in Stockholm exchanging notes about degrees of 'karbonate hardness', sulphate concentration, general hardness and the pH of their brewing water. Brewers have long known that waters with different compositions lend themselves to different beers. Rather than import the 'soft' water from the Czech Republic for their pilsener-style beers, brewers learnt to make their own water with the properties of Pilsen water. By starting with distilled water and adding a few minerals to the water, a brewer in London, where the tap water is relatively 'hard' and better suited to ruby-dark porters and pale ales, could make crisp, golden pilsener beers with clean 'hoppy' flavours.

What is water?

In its simplest form, water is a couple of hydrogens (two positive charged atoms; H^+) stuck to an oxygen (a doubly negative-charged atom; O^{2-}) to make a molecule; H_2O (see Figure 2.1). Pure water is actually H_2O mixed in with some H^+, H_3O^+ ($H^+ + H_2O$) and some OH^-. These compounds are continuously recombining; this is one of the aspects of water that makes it uniquely chemically useful (see Video 2.2). Pure water only occurs just after evaporation, or if we've forced it to separate. The rest of the water on, above and within the planet has other stuff mixed in with it.

Water is different everywhere. It all starts off as distilled water in clouds, which then becomes rain. Distilled water has a pH of 7 (neutral) but clouds react with carbon dioxide (CO_2) in the atmosphere to form weakly acidic vapour. Some clouds react with sulphur dioxide (SO_2) to form acid rain, but most don't. Most clean rain is slightly acidic, usually a little above pH 5.7, which is fine for us and most of the lifeforms on the planet. Eventually, the air cools, the clouds condense and water will fall to the earth. Some will seep around rocks, some through layers of soil, some through decaying organic matter. Others collect into streams, lakes and compacted snow, cutting through rocks and even moving mountains. Still others fall on city roads and drop, together with the soggy pickles from last night's kebabs, into sewers. As water seeps through soil, cuts through gorges, runs through pipes and heats up inside your kettle, it picks up minerals. Every natural spring and city pipe contains different mineral content depending on the route it took to get there. If we let it, this affects how water extracts our coffee and the resultant taste of our coffee.

Chemical extraction

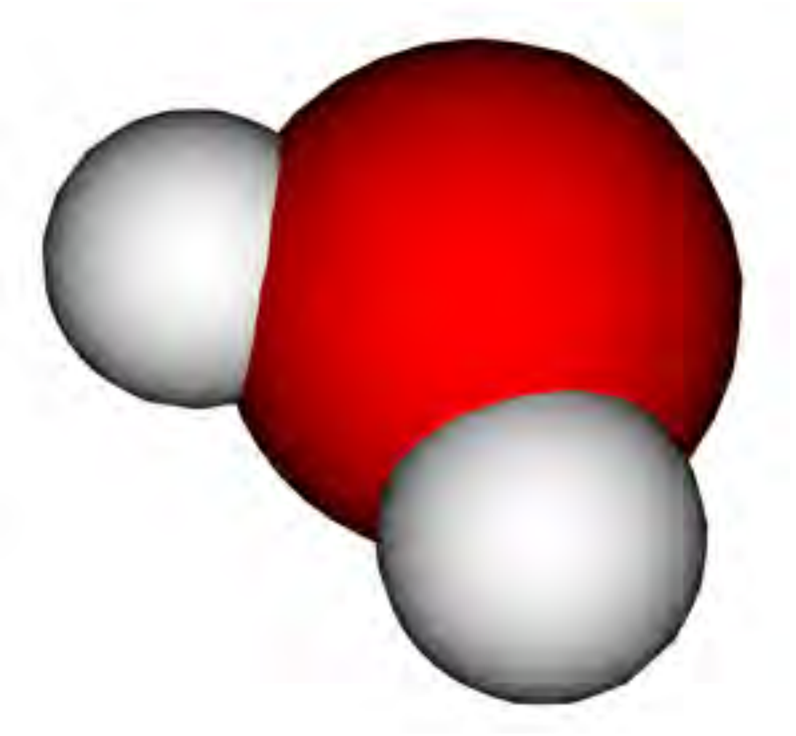
Water is a bent polar molecule with two partially positive hydrogen atoms and one partially negative oxygen. Three properties make water a great solvent: (1) polarity, (2) thermal conductivity and (3) the ability to form cages.

Water molecules dissolve coffee compounds by competing with weak intermolecular bonds between coffee compounds and separating the compounds from their neighbours.

Water also transfers heat energy to bonds within compounds, helping to break them apart.

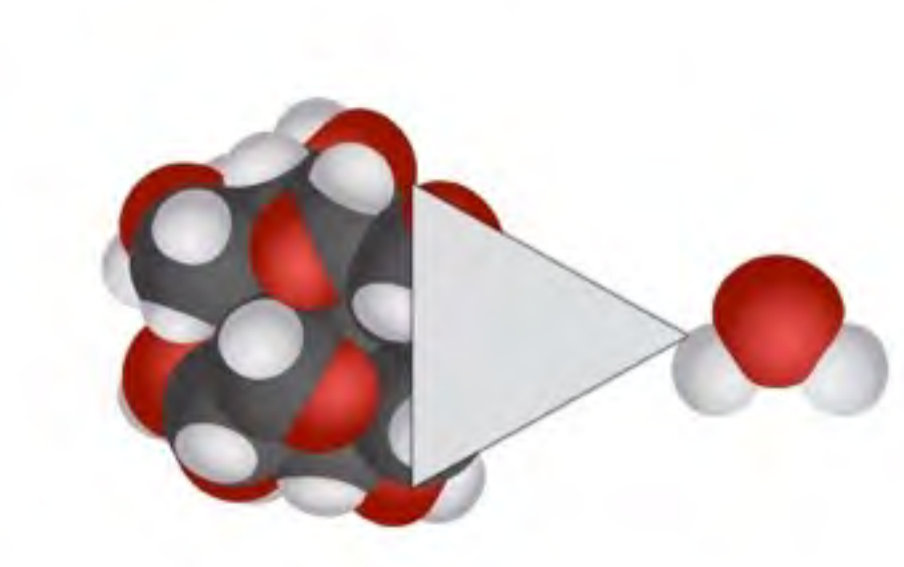
Water can partially dissolve non-polar molecules like lipids by forming cages around them (see Video 2.1).

Figure 2.1 Space-filling model of water



Water is a bent molecule with two partially positive hydrogen atoms (white) and a partially negative oxygen atom (red).

Video 2.1 Water, the universal solvent



Underlying principles

Hardness (GH)

Hardness comes in two varieties that are of concern to us: general hardness (GH) and carbonate hardness (KH).

GH comes from dissolved calcium (Ca^{2+}) and magnesium (Mg^{2+}). It's likely that the GH in your water supply comes mostly from calcium. Calcium and magnesium ions attract water molecules around them, making the water an even better solvent. This adds potency to the competition between the polar bonds within coffee and the polar pull of the water. A higher GH gives water the 'ionic strength' to dissolve and extract more organic molecules than water alone. (see Video 2.2).

KH comes from dissolved bicarbonate (HCO_3^-). KH is also known as temporary hardness because it will combine with calcium and magnesium and precipitate out of the water as calcium carbonate ($CaCO_3$) or magnesium carbonate ($MgCO_3$) when the water is heated. In contrast, dissolved sulphate ions (SO_4^{2-}) remain dissolved in boiling water and, along with calcium and magnesium, contribute to permanent hardness.

Video 2.2 Water and GH

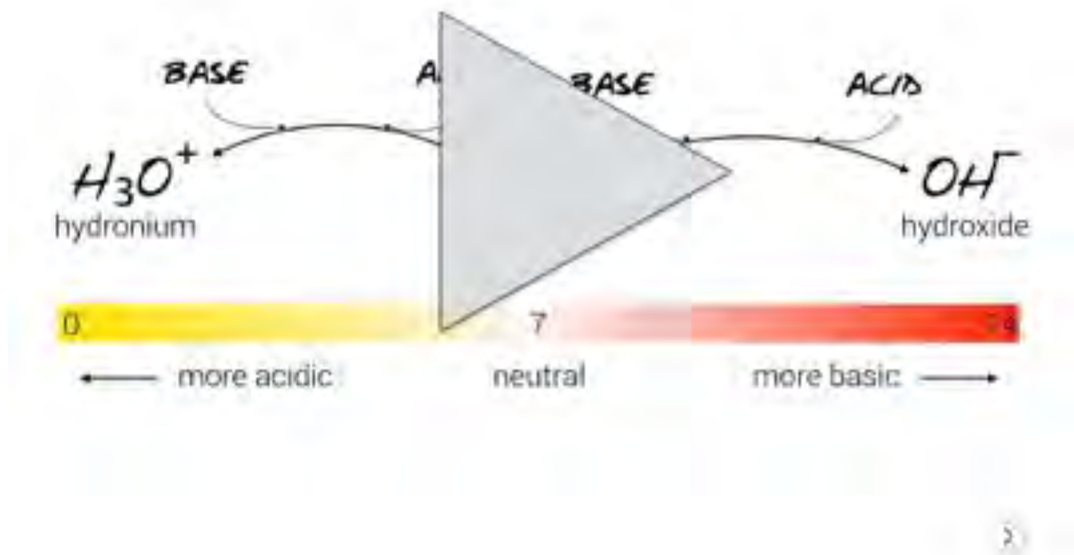
Some areas have soft water, where the water is a thin soup of dissolved ions and, in other areas, the water is hard as a thick ionic goulash.

When people refer to hard water as opposed to soft water, they usually count the GH and KH together. For our purposes here, we want to measure the concentrations of calcium, magnesium and bicarbonate separately.

Sample

That's the end of the sample for this chapter. The rest of the book is at Coffeegen.

Video 2.3 pH



Grinding

Many baristas will tell you that the most important piece of equipment in the cafe is the grinder. Despite this, it is a piece of equipment that is very often overlooked and under-maintained. It also causes baristas the most frustration.

Thinking About the Grind

Grinders

For years, the grinder seemed to be the barista's single greatest obstacle to making good espresso coffee. I once congratulated one of the old gentlemen of Anfim over their Super Caimano Barista grinder and he responded that he didn't understand the need for the dosing chamber on an electronic dosing grinder and that the cooling fans were overkill. He went on to say that the Super Caimano was a cheaper option. I walked away from the Anfim stand, bemused that the manufacturer of my favourite grinder at the time didn't *capisce* my enthusiasm.

In 2013, Matt Perger used one grinder to grind different coffees during his World Barista championship performance in Melbourne. It was an extraordinary performance on many levels, but the most exciting thing for many of the baristas watching was that he used an EK43 – a 1980s shop grinder – to grind all his shots. He explained that this grinder created less fines than any other he'd tested and, by dropping pre-weighed doses through the vertical burrs, the wastage was close to zero.

We immediately went out and bought several.

In 2013, Nouva Simonelli released the Mythos One, a grinder that had been developed in collaboration with what is the coffee equivalent of the G4 of Hoffmann, Harmon, Davies and Storm. The machine takes a very different approach to ensuring consistency. Instead of just cooling the grinding burrs using fans, the Mythos One heats the burrs to 35ºC (95ºF) and the fans only kick in once the temperature threatens to go over 45ºC (113ºF). This meant less expansion and contraction in the burrs due to use and greater consistency. The Mythos One is based on the earlier Mythos model, which has the grinding burrs mounted at a 30º angle, resulting in less than a gram of retention and far more cost-effective grind changes.

We immediately went out and bought several.

In 2015, Sasa Sestic used an Anfim SP450 to grind his coffee for the World barista championship in Seattle. He won. The win probably had something to do with his indefatigable preparation and the *Coffea arabica* var. *sudan rume* that he used.

Nevertheless, we immediately went to the storeroom and pulled one out, and then several.

In 2016, Lyn Weber released the EG-1 grinder that looks like it takes coffee to the stars. Their vision of the future: back to single dose grinding.

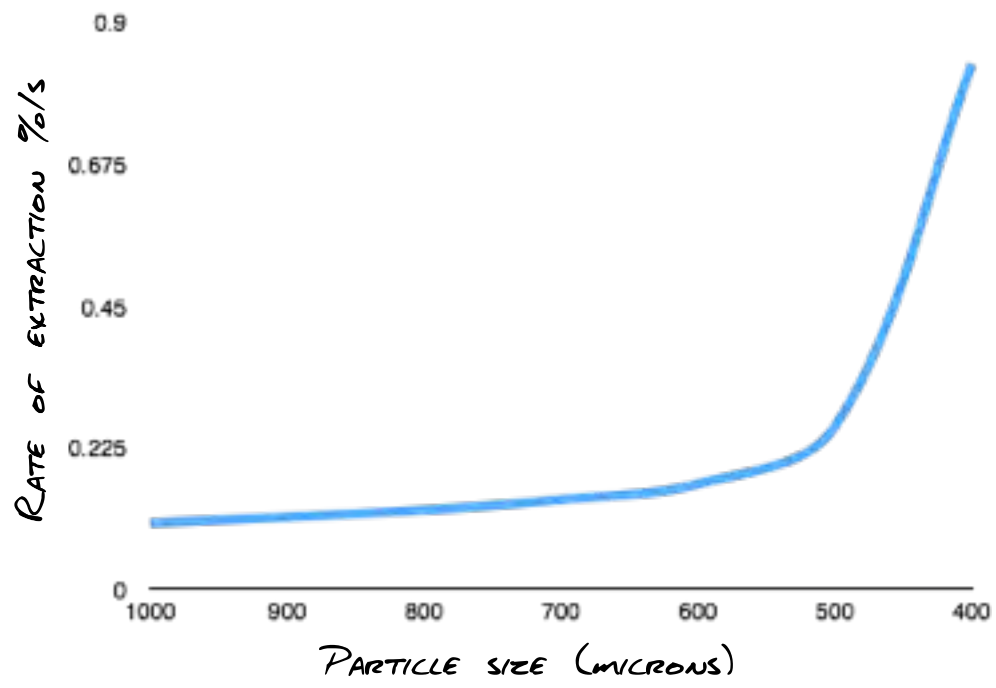
Grinding is a very complex thing. Clearly, no one manufacturer has yet created the perfect grinder, but now that speciality cafes are so ubiquitous, the industry has a financial incentive to cater for flavour and consistency, and improved designs have since been trickling in like a tight espresso pour.

Why grind? A cup of coffee is the result of extracting coffee from roasted coffee beans using water. We break the beans up to expose more surface area to the water. This gives the water access to the flavour compounds within the coffee and these compounds diffuse into the water. Figure 3.1 shows that the finer we grind, the greater the difference will be in the rate of extraction between the sizes of grind.

Surface area

Take a hand full of beans, boil them and you will brew coffee, but it's going to take a while before the brew is strong enough to be worth drinking. The surface area for a coffee bean is around 3.4 cm^2, which means 3.4 cm^2 of water contact. Grind that bean for espresso, and the contact area expands to around 3400 cm^2. The small red circle to the right represents the surface area of a coffee bean and the larger brown circle represents the surface area of the same bean ground for espresso. With more surface area exposed to water, it's much easier and faster for the water to extract the flavours from the espresso grinds. The greater the surface area, the greater the rate of extraction will be.

Figure 3.1 Rate of extraction vs particle size



Source: MPE Chicago

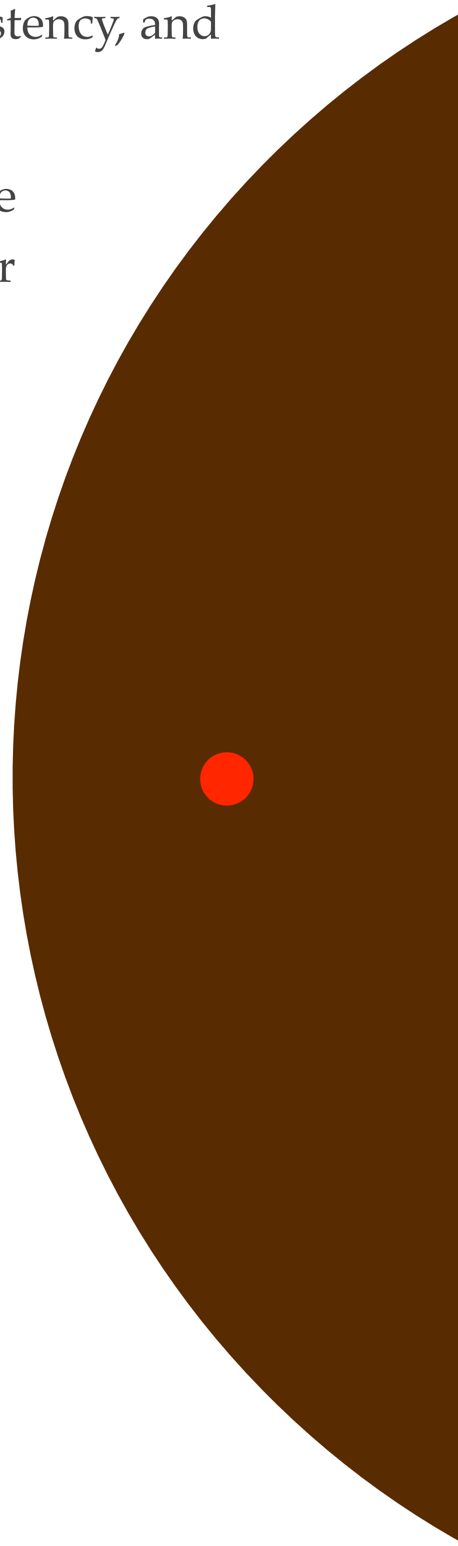
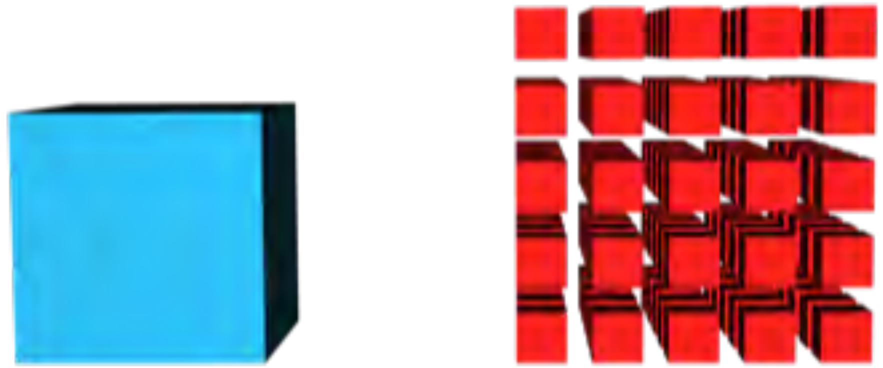


Figure 3.2 The relationship between the surface area of a given mass of material and the size of its particles



Each face of the large blue cube has 100 cm² of surface area. The cube has six faces, so the cube has a total of 600 cm² surface area. If the same cube of material were cut into smaller cubes so that each cube were only 2 cm on each side, then the same mass of material would now be present as 100 smaller cubes. Each face of each red cube would have 4cm² of surface area, giving 24 cm² of surface area for each cube. The total mass would therefore have 2400 cm² of surface area. This is four times as much surface area as the large blue cube. When we grind finer, we increase the particle count, leading to a large increase in overall surface area even for a small change in grind size.

Extraction

Extraction is what we do with our ex-patriates in a war zone: we pull them *out* of the war zone. The water is doing something similar with the flavours from coffee. Just as we might extract people out of the war zone in the order of children, women, men and soldiers, the flavours extract out of coffee grinds by size in order of the small interesting aromas first, followed by fruity, caramelly, grainy and finally the larger bitter compounds (apologies to all soldiers). Because the rate of extraction is related to the surface area, small grinds with their large surface area rapidly give up fruit, caramel, grain and all the bitter to the water, while larger grinds might still be giving up their caramels. It's important to understand this because coffee grinders are rubbish at grinding a uniform size.

That's the end of the sample for this chapter. The rest of the book is at Coffeegen.

How to Drink Coffee

The magical thing about coffee is how complex the flavours and tactile sensations are. Like the best witches, we need to become excellent at tasting to enhance our brews.

Sensory Perception

Discovering the fifth taste

Until the 1980s, Westerners were only allowed four tastes at the dinner table: salty, sweet, sour and bitter. Meanwhile, for over seventy years, around *chabudai* in Japan, everyone was enjoying a fifth taste in their miso soup: umami.

Umami was isolated in 1907 by Kikunae Ikeda, a professor at the Imperial University Tokyo who was studying *dashi*, a Japanese soup base containing fish stock, tuna flakes and *kombu* seaweed. Ikeda identified that the predominant taste in *dashi* wasn't sweet, salty, sour or bitter – the four accepted tastes at the time – and he set himself the task of isolating the mystery taste. He broke *dashi* down into its constituent parts and eventually isolated monosodium glutamate in kelp.

In 1909, he published a paper that was received with scepticism if not completely ignored by many food scientists at the time. The fact that the research was written in Japanese probably didn't help its acceptance in the West, but there's also a crossover with salty and sour when umami is very concentrated, which muddled people's perception of this fifth taste.

Ikeda's research assistant subsequently isolated a second umami compound, disodium inosinate, in tuna flakes. Finally, in 1957, a third compound, disodium guanylate, was identified by Akira Kuninaka, who worked for Yomasa soy sauce.

The world finally accepted umami as the fifth taste after the First International Symposium on Umami in 1985 made umami cool. Since becoming socially acceptable, people started admitting that they'd been enjoying umami daily in many foods including ketchup, Italian tomato sauce, many cheeses, and everyone's favourite: marmite.

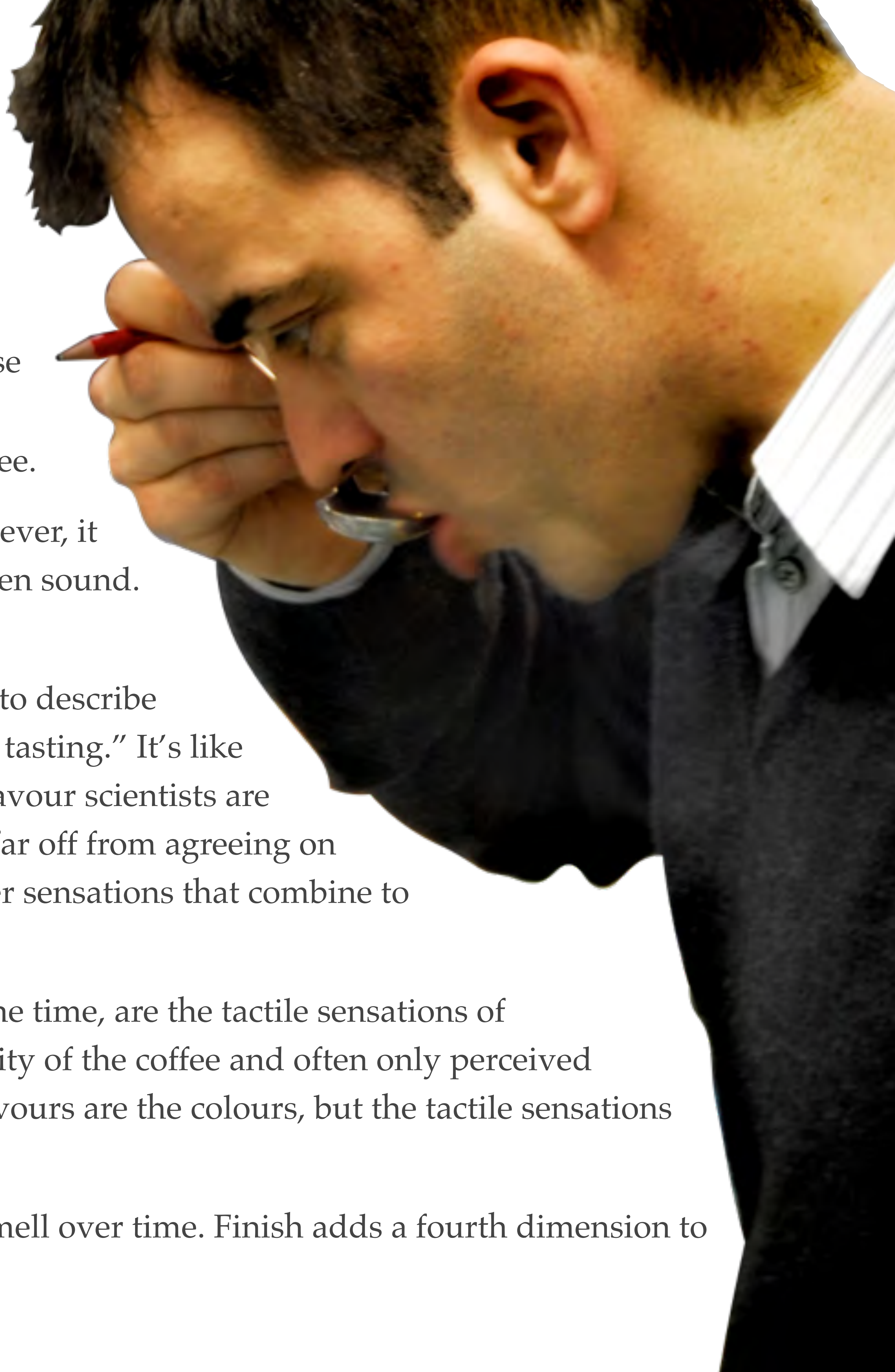
Then, in a bid to outdo the Japanese, the Europeans decided that they'd been doing umami since an ancient Greek, with a penchant for fish guts and blood, discovered that salting the piscine viscera and leaving them out in the sun for three months made a great umami sauce. That sauce was called '*garum*' and had been greatly enjoyed by the Romans and Greeks for millennia.

Umami means 'pleasant, savoury taste' in Japanese and is mushroomy, savoury and musty. It is mild and doesn't necessarily taste pleasant on its own, but its great strength is that it changes our perception of other tastes, especially salty and sweet. It works like a supporting cast member; like a Bond girl who's not essential to the plot but adds a great deal of 'chutney' to the film. When we wrap smoked salmon around a slice of melon, spread marmite on our cheese-on-toast, caramelise our onions or barbecue meat, we're introducing umami to other tastes and augmenting the sexy.

Not only was umami one of the latest tastes to be recognised but it was also one of the latest for us to evolve. It seems that our ability to perceive umami came at about the same time we started cooking. Our bodies produce glutamate so that we don't need an external source. However, glutamate, along with many other amino acids, is released when food is cooked. It's probable that our preference for glutamate came about after we worked out how to produce fire, and that it is a marker for other heat-released amino acids.

After the acceptance of this fifth taste and the explosion of a long-taught tongue map, scientists presumably thought "Well, if there's a fifth taste that we missed for so long, then maybe there's a sixth." Contenders for a sixth taste include CO_2, calcium, kokumi (heartiness), piquancy (spicy), coolness, metallicity and fat (oleogustus).

Sampling the brew



Every time we brew a cup of coffee, we're conducting an experiment. We can use instruments to take measurements, but the proof of the coffee is in the drinking.

When we drink, our tastebuds and **olfactory epithelium** sense flavour particles while the **somatosensory** receptors – on our lips, mouth walls and throat – sense the tactile aspects of coffee.

Flavour is our perception of taste and aroma combined. However, it also combines with sight, texture, temperature, memories, even sound. Flavour is flavoured by our entire sensory experience.

The complexity of flavour is something that we find difficult to describe because we can't point to anything that says "that's what I'm tasting." It's like trying to describe colours to a person who has never seen. Flavour scientists are probably halfway in categorising the tastes but are still very far off from agreeing on categories of aromas, much less the complexity of all the other sensations that combine to give us flavour.

Even less obvious, but something we nevertheless sense all the time, are the tactile sensations of mouthfeel, body and aftertaste. These are integral to the quality of the coffee and often only perceived subconsciously. If you think of coffee as a picture, then its flavours are the colours, but the tactile sensations give us the shape and shading to make the image stand out.

Another sensation, **finish**, is our perception of touch, taste, smell over time. Finish adds a fourth dimension to our perceptive experience.

As baristas, we should be drinking and thinking about coffee often. We need to critically consider the flavours and tactile aspects of coffee to bring subconscious perceptions forward; towards consciousness. Every time we drink a cup of coffee, we are calibrating and maintaining our senses.

Temperature

Presumably, we spent much of our time evolving in Africa without access to a microwave, and so it's not very surprising that we perceive best between 20–30ºC (68–86ºF). Temperatures hotter and colder than 20–30ºC alter our perception of flavours by the phenomenon of thermal taste. We need to keep this in mind while we drink our coffee and taste it as it cools.

This doesn't mean that we should serve our coffees at 30ºC (86ºF). Despite our poorer ability to taste at higher temperatures, we have developed the expectation that the coffee should be hot; a quick scan of TripAdvisor's restaurant reviews show that people get mightily upset over tepid food or drink when they expect it to be hot.

Senses used in cupping

The method of sampling coffee in the industry is called 'cupping': take a cup, grind some coffee, add some water, and slurp it with a spoon. We'll examine cupping in the next section, but first we'll look at the senses we use while cupping: gustation, olfaction, the tactile senses and finish.

Gustation

We sense taste (gustation) by using the tastebuds on our tongue, soft palate, upper oesophagus and epiglottis. Each taste is a nutritional marker for what the food can offer. Salty, unsurprisingly, indicates salt, which helps maintain water balance. 'Sweet' promises that we'll be getting energy. Umami gives the suggestion of released amino acids. Sour promises acids. Lastly, bitter gives us the primary point of taste: to decide whether to swallow the food in our mouths or to spit it out. As many poisons are bitter, we have a natural aversion to it. However, if our cave-dwelling ancestors found something that was bitter and not poisonous, it could represent a whole new source of nourishment in scarce times. This might explain why some people prefer craft brewed bitter ales. Or, say, coffee.

Coffee beans have compounds called alkaloids that are bitter – caffeine is one of them. These bitter compounds deter insects from eating coffee cherries and can paralyse and even kill some would-be pests. It's not a blanket insecticide, however. Caffeine enhances the reward memory of some **pollinators** and, happily, the effect of caffeine on humans is agreeable.

There are two major species of coffee that are cultivated for consumption: *arabica* and *robusta*. The speciality industry uses *arabica* beans because they have half the bitter alkaloids as *robusta* and twice the sugars, which makes *arabica* much more attractive to both insects and baristas who prefer their customers to leave off the sugar cubes.

In 1931, Arthur Fox, an engineer working at Dupont, accidentally released a cloud of a chemical called Phenylthiocarbamide (PTC) into the lab. A co-worker nearby commented on how bitter the compound was, but Arthur couldn't taste it at all.

Fox tested members of his family and friends and discovered that 70% of those tested could taste the bitterness of PTC, with 25% of that group having an extreme reaction against the taste. The remaining 30% could not taste the bitterness of PTC at all.

Should the 30% of the population who can't taste bitter be prevented from becoming baristas?

That's the end of the sample for this chapter. The rest of the book is at Coffeegen.

Espresso

This is the sexy one. The one that makes all the money for the cafe. It's the most common coffee type... and it's often the worst prepared.

Espresso, 1822 to Today

How espresso has changed the coffee service

There's a cafe in Melbourne, Australia called Batch Espresso that hid their Slayer espresso machine behind a blackboard. I was curious, so asked Jason Chan, the owner, why he'd hidden away one of the prettiest machines on the market. He proceeded to give me a philosophical treatise on espresso service: it wasn't about the machine, it was about the craft and the service. Batch Espresso was going through 60 kg of coffee a week in 2012. That's over 400 coffees a day. A lot for an independent cafe. I've got one cafe doing that much and it is three times the size of Batch. Jason told me that League of Honest Coffee with two Slayer machines working together was pulling 200 kg per week. 60 kg is small in Melbourne. He pointed across the road and said, "That place is doing 125 kg, that one there 80 kg, that one; 100 kg".

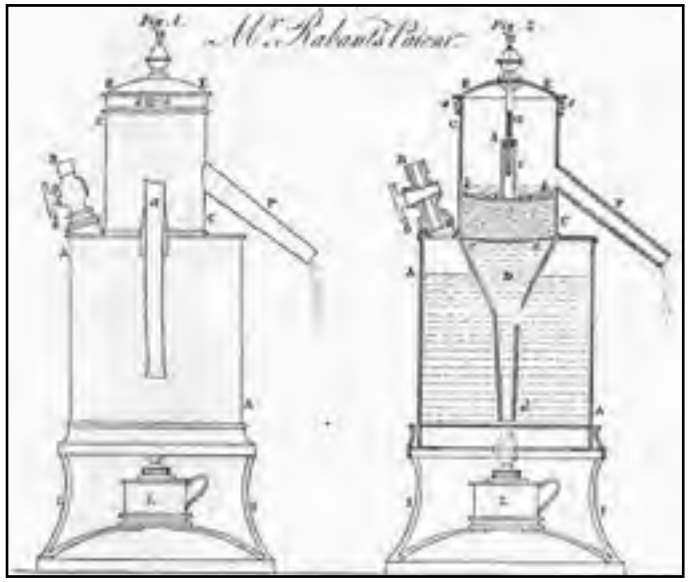
400 coffees in a ten hour day is one coffee every 90 seconds back-to-back, throughout the day. The easiest way to achieve this would be to have an 80 L boiler with coffee on tap. This is how coffee used to be served everywhere and still is in many parts of the world. It's a thick, black, stale, bitter brew that melts the cheap alloy spoons used to stir in the copious quantities of sugar that make it palatable to anyone with a decent complement of tastebuds. None of the Melburnian cafes used vats – they were all serving coffee made at the time of order. This ability to quickly get out great numbers of coffee, made at the time of order, was only possible after the invention of the espresso machine. Coffees made quickly to order is what espresso is all about.

A short history

Rabaut

In 1822, Frenchman Bernard Rabaut, invented a steam-based coffee machine (Figure 5.1). It compressed coffee between two perforated plates that sat between a lower and upper chamber. Water was boiled in the lower chamber to produce steam, which then rose through the coffee and into the upper chamber as an extract. This machine could produce over 2,000 cups of coffee an hour. However, the resulting brew could hardly be considered espresso by the glossary definition – it could barely be considered potable.

Figure 5.1 A device for extracting coffee by the force of steam



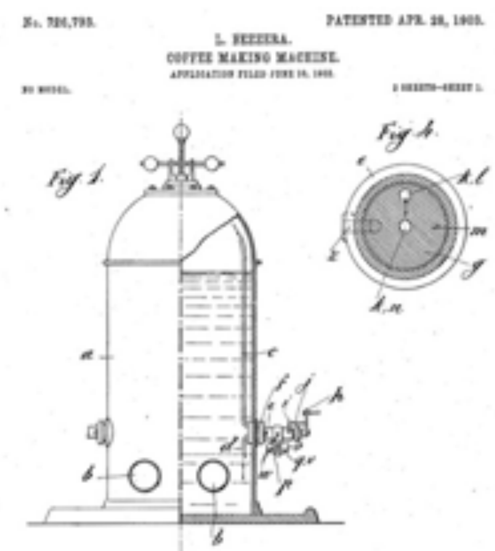
Andrews

In 1841, Englishman Ward Andrews invented a machine that used a piston to force a measured amount of water up through the coffee. This was a good advancement but was still without the pressure needed to emulsify oils and create brew colloids.

Bezzera

In 1901, an Italian finally got in on the act. Luigi Bezzera filed a patent (Figure 5.2) for a boiler with four groupheads that could rapidly produce coffees on-demand. He used this in his busy *caffe*. The pressure for the extraction came from the steam, which passed through the coffee giving a very bitter extraction.

Figure 5.2 Patent for Bezzera's coffee making machine



Cremonese

In the 1930s, Sr. Cremonese, a coffee grinding technician living in Milan, worked out a way to apply pressure using a screw piston. This system produced the pressure needed for espresso without the high temperatures from steam.

Gaggia

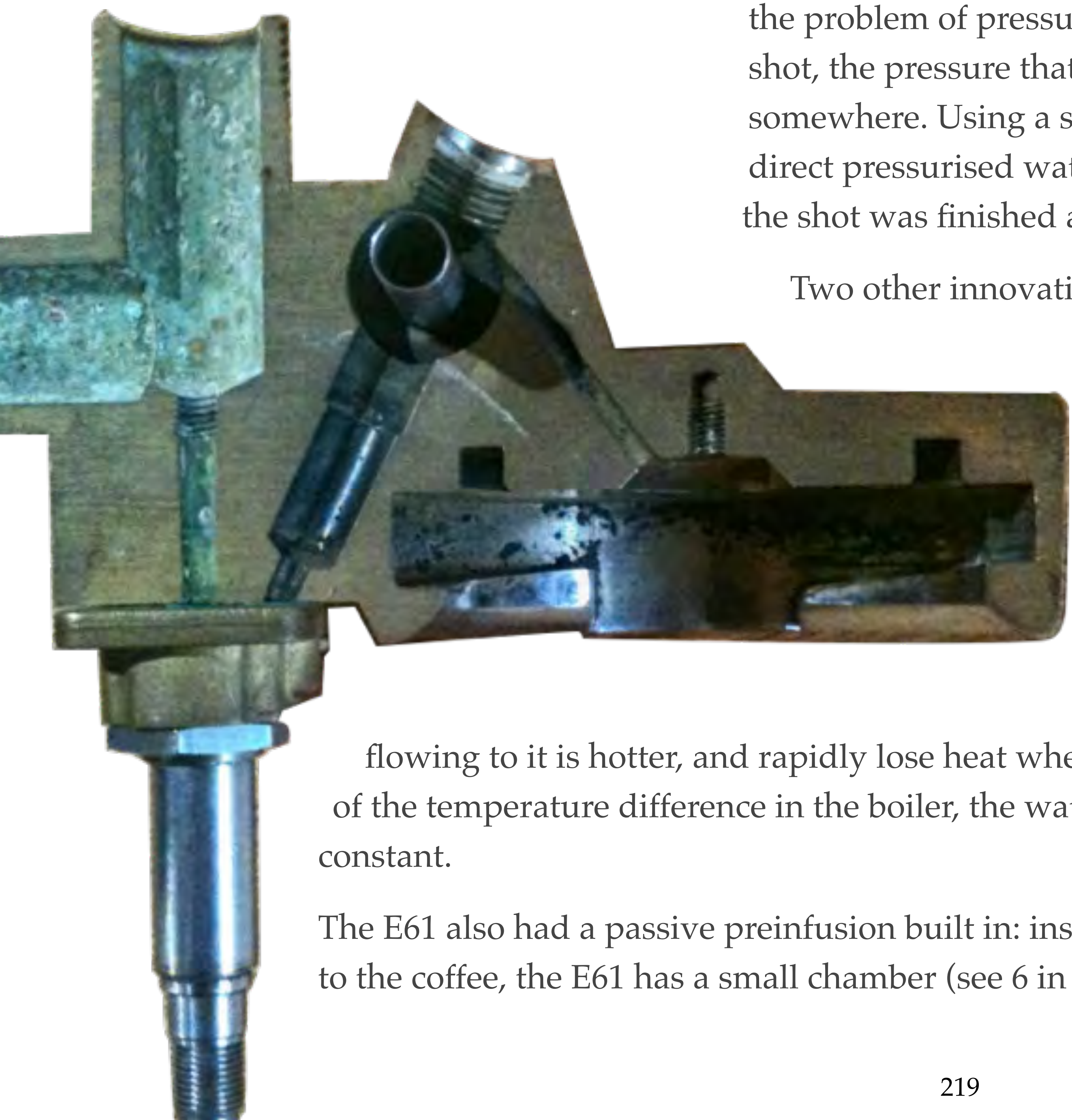
In 1938, Achille Gaggia patented his first steam-free piston system. It was very similar to the Cremonese system, requiring a payment to the widow of the now deceased Signor Cremonese. He tinkered with it over several years adding a boiler to the system and developing a spring-powered piston, which he patented in 1947 (Figure 5.3). He discovered that if he used consistent fine coffee grinds he could produce a foam with the coffee, resembling something we might recognise as espresso. Gaggia quickly capitalised on his discovery, installing his machines in bars and putting up a sign that read "*Caffe crema di caffe natura*" (coffee cream from natural coffee). The espresso craze had begun.

Figure 5.3 Gaggia's spring-powered piston

Faema

In 1961, Faema introduced the E61. This espresso machine was the first to use a pump that pressurised the water. The innovation that enabled the use of the pump was the pressure-release valve in the E61 grouphead (Figure 5.4). It addressed the problem of pressure buildup in espresso machines: after we stop the shot, the pressure that has built up behind the puck needs to go somewhere. Using a solenoid to direct the flow, the grouphead could direct pressurised water to the coffee and then release the pressure once the shot was finished as shown in Video 5.1.

Figure 5.4 Section cut of an E61 grouphead



Two other innovations made the E61 grouphead superior to anything before it: the thermosyphon circuit and 4 kg of brass. The thermosyphon circuit takes hot water from the top of the boiler, runs it through the grouphead and sends it back to the bottom of the boiler. This heats up the 4 kg of brass that makes up the grouphead.

Brass has great thermal conductivity and will rapidly absorb heat when the brew water flowing to it is hotter, and rapidly lose heat when the water is cooler. This means that regardless of the temperature difference in the boiler, the water coming out of the grouphead will be relatively constant.

The E61 also had a passive preinfusion built in: instead of the water flowing from the pump directly to the coffee, the E61 has a small chamber (see 6 in Figure 5.5) that fills up as the pressure builds.

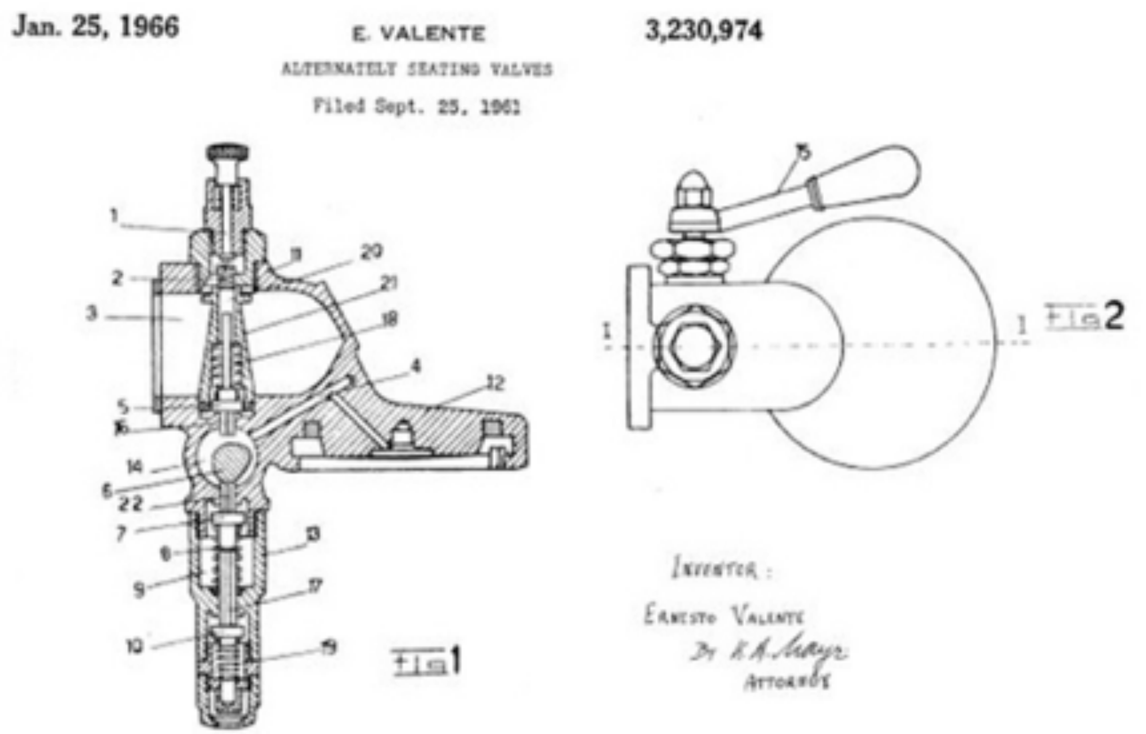
This way the puck gets a decent soaking at lower pressure before the full 9 bar of pressure starts pushing through.

The E61 was named for the eclipse that occurred in 1961, the year it was released. It's been a few years since then, but despite many technical advances in many parts of the machine, the grouphead that you're using to pour a good 'spro is very similar to the original E61 design.

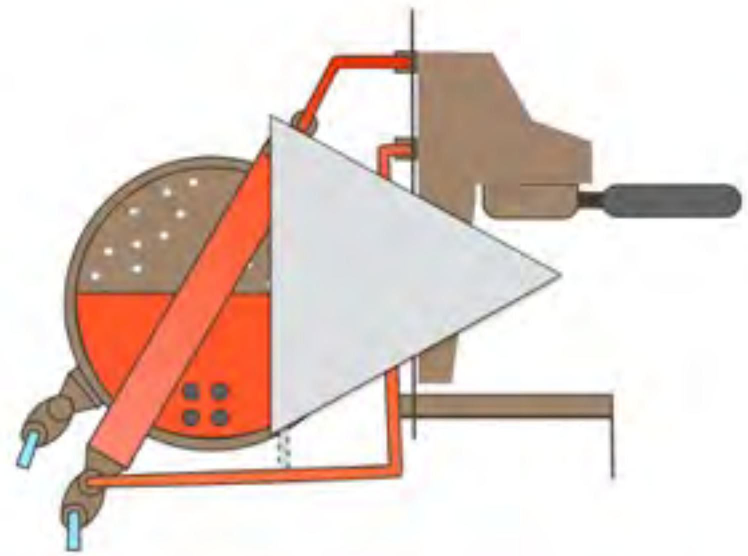
The ability to craft individual coffees that tasted fresher was what drove people to experiment and invent new ways of preparing coffee. The drive from Ward Andrews onwards was about the craft and the service.

Now that we've got something that can produce decent espresso shots, flick to the next chapter to go over the basics of how to use it.

Figure 5.5 Diagram from patent application for E61 grouphead



Video 5.1 Simple mechanics of the E61



5.1 Key learning points

1. 1822: Rabaut puts steam through coffee.
2. 1841: Andrews uses a piston to enable consistent brew ratios.
3. 1901: Bezzera uses steam to provide pressure.
4. 1930s: Cremonese uses a screw piston to provide pressure.
5. 1938: Gaggia snaffles Cremonese’s idea and by 1947 he’s got a boiler and a spring powered piston.
6. 1961: Faema introduce the E61 with a pump to supply the pressure; pressure release valve; 4 kg of brass in the grouphead providing thermal inertia; and passive preinfusion.

Review of Espresso, 1822 to Today

Question 1

Who invented the first machine that made espresso?

A. Bernard Rabaut in 1822

B. Luigi Bezzera in 1901

C. Achille Gaggia in 1947

D. Faema in 1961

Question 2

Which of the following are advantages of the E61 grouphead?

A. 9 bar of pressure

B. Passive preinfusion

C. Thermal inertia

D. Variable pressure

E. Thermosyphon circuit

Question 3

Why does the E61 require a pressure release valve?

A. The pressure is supplied by a pump with one way flow

B. To supply steam for milk

C. In case there is a lunar eclipse

D. To stop the shot

Review 5.1 Answers

Question 1

Correct answer: C

Question 2

Correct answer: B, C & E

Question 3

Correct answer: A

The Espresso Gospel

This section on the espresso base is a quick run-through of how to make a half-decent espresso coffee. Treat it as gospel. Watch, imitate and practice heaps. We'll look at the more complicated aspects of espresso in Section 3.

What is ‘espresso’?

Espresso is a method of coffee brewing that uses pressure. Most espresso machines use 9 bar of pressure to extract the coffee. Your average car tyre is pumped up to around 2.2 bar, so the pressure going through the coffee is 4 - 2 5 times the amount of pressure in your car tyre. Because we have so much pressure pushing down on our coffee, we have to pay attention to our preparation.

Base

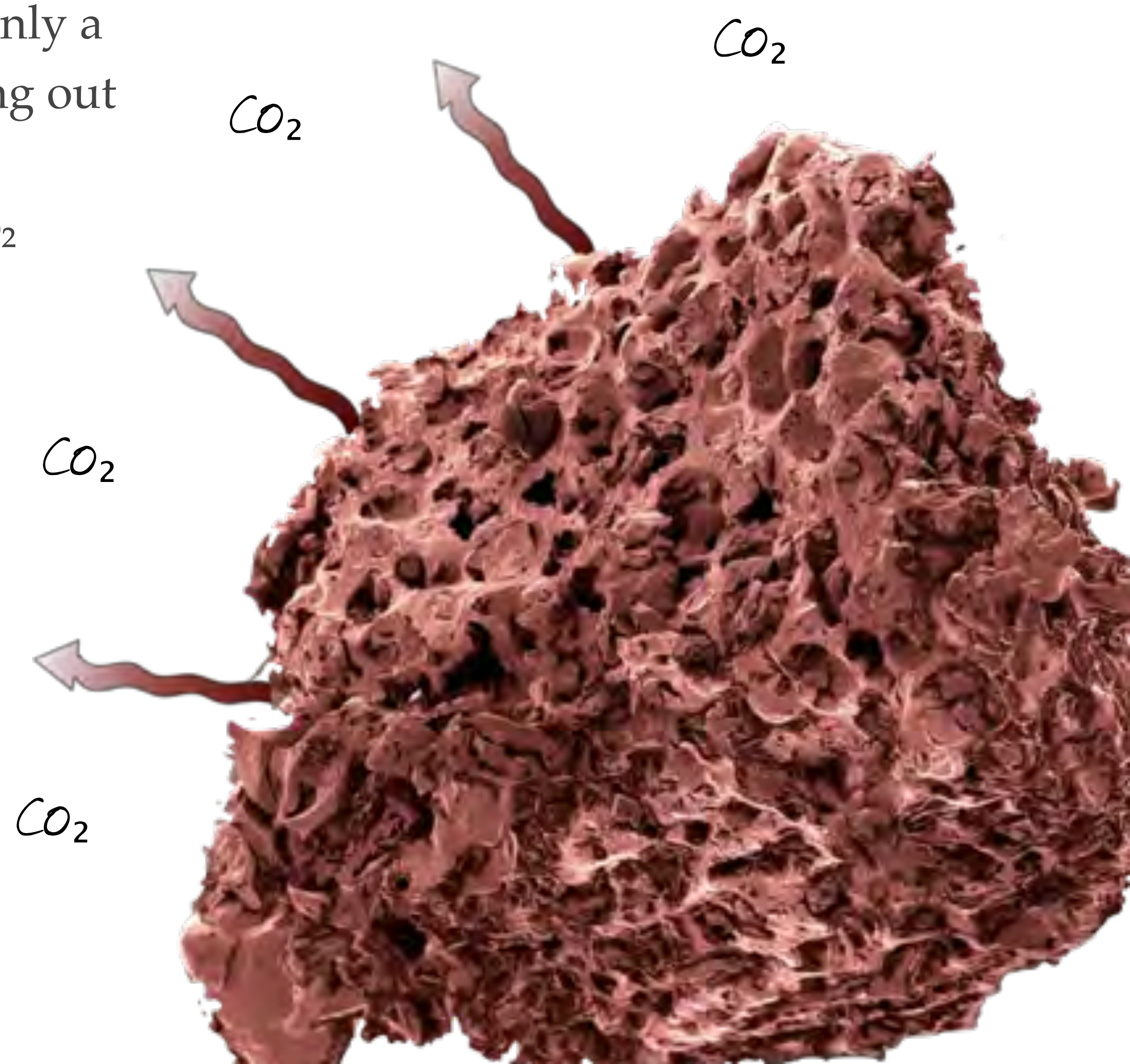
The base is the shot of coffee. It’s also called a ‘short black’, or ‘espresso’. A good base has a delicious balance of acidity, sweetness and bitterness with interesting aromas and a resonant finish.

The grinds

You have to keep the coffee fresh. Good coffee beans keep fresh for only a few weeks after roasting. Over the course of this time, it will be giving out CO_2 gas. When we grind coffee beans, we expose heaps more of the bean’s surface area to the atmosphere and the coffee will give up CO_2 gas much faster.

Only grind as much as you need for the next cup. Never fill the dosing chamber. If you grind and wait, the amount of CO_2 in your coffee will be less and will slow down the speed of your pour. Wait longer and the oils in your ground coffee might go rancid.

That's the end of the sample for this chapter. The rest of the book is at Coffeegen.



Milk

In terms of volume, many cafes sell more milk than coffee. That makes it important to our trade so, like it or not, we need to jump right in.

Photo by Astra Plepe

Milk for Coffee

Coffee in Izmir, modern Turkey. Strictly no milk.

How milk got into coffee

The first coffeehouse in Europe was the Angel Inn and was opened by Jacob, a Lebanese immigrant, in Oxford, 1651. The coffee was black and of a style similar to the Turkish/Greek/Arabic coffee that is today found in the region between Greece and Yemen. The first coffeehouse in London opened in 1652. In the decades afterwards, coffeehouses spread across Europe like ye olde Starbucks stores but with one crucial difference: all were serving the coffee black.

The French got cafes after 1669 when Soliman Aga, the very fashionable Turkish ambassador to France, introduced coffee to the court of Louis XIV, but the *café au lait* (and the croissant) didn’t make it into the country until the Austrians had made it more fashionable to dislike the Turks. It took the Battle of Vienna before people were ready to put milk into their coffee.

After the Turks unlaid their siege on Vienna, 11 September 1683, a few chancers opened up coffeehouses with the coffee that the hasty Turks had left behind. Considering that the Turks had besieged the Viennese population for two months it’s not surprising that they didn't immediately take to the black ‘Mohammedan brew’. However, someone had the good idea of adding milk and sugar to the cup, and suddenly good Christians East of the Rhine were drowning their crescent-shaped pastries in a cup of milky coffee. Take that, Johnny Turk!

Today, espresso is drunk more often white than black. So milk is an essential part of what we do. But let’s not get ahead of ourselves; it’s still not as important as the actual coffee. If you’ve skipped the espresso base section, shame on you! Customers return for the *coffee*! As Meghan Trainor once said, “It’s all about the base,” and I’m certain she was talking about coffee. Go back, get the base right, and then come back and read on!

Types of milk

There are herds of different milk available, and if you're pouring **lattes** milk is most of the drink. Generally speaking, the fresher the better; but there's so much more to consider. It doesn't always follow that the best milk is the best for your coffee. Some milks are too creamy and will mask the flavour of the coffee. You need to experiment with the coffee that you're using and play with all those different types: organic, homogenised/farm fresh, pasteurised/unpasteurised, full fat/low fat, etc.

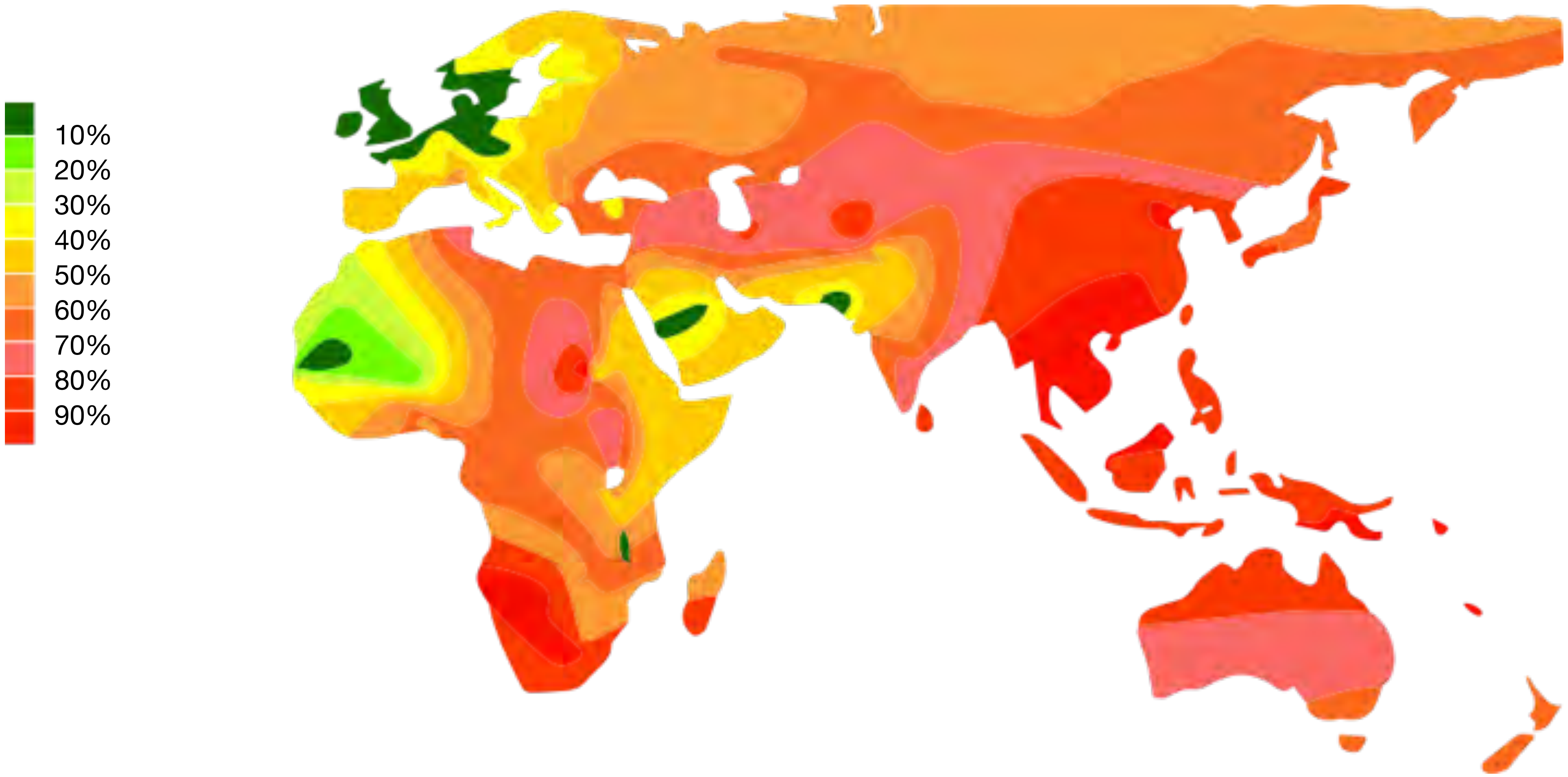
Low fat milk tends to foam more than full fat milk. I don't have low fat milk in most of my cafes because I find it a pain to work with and prefer to eliminate this extra variable in preparation. A word of caution: this will alienate some customers. Personally, I feel that milk only adulterates the coffee, but if we're going to serve it then it should be creamy.

Double filtered milk is more consistent and suffers less from issues when the cows change their feed. Interestingly, in his 2013 World Barista Championship semi-final round Matt Perger used milk from a cow called Freckles who was put onto a clover patch the day before milking. The possible variations here are endless.

Milk substitutes

Lactose intolerance is common, especially in parts of South-East Asia and Southern Africa where it can reach 90% of the population (Figure 6.1). Soy milk is usually the best alternative to cows' milk but there are others, such as oat, rice and coconut milk, and there are bound to be plenty more. When sourcing lactose-free alternatives, I usually look for flavour, creaminess and ability to achieve good latte art. We usually heat the soy milk a little less than cows' milk to make decent latte art.

Figure 6.1 Lactose intolerance levels



Coffee definitions by milk content

The definition of a coffee is up to the owner or manager of the cafe. There is no cappuccino recipe for all to follow; if there were, such a definition would have to change over time.

Many cafes have done away with the Italian names, preferring a simpler ‘black / white’ and the size of the drink. Even so, customers tend to ignore the coffee menu and order whatever they’re used to. If in doubt, ask them to describe the coffee they’re after and try your best to give them what they want.

If I were going to a cafe, this is what I’d expect the definitions to mean:

	Black Boona Estate	White Fazenda Puta Madre
Short	£$¥	¥$£
Long	£$¥	¥$£

Flat white

Base with textured milk and very little foam. 170 mL.

Caffe latte

Base with textured milk and around 10% foam. 230 mL.

Cappuccino

Base with textured milk and 20-33% foam. 170 mL.

Macchiato

Base with a dab of foam. Served in a small cup. 40 mL.

Piccolo

Base with textured milk and very little foam in a small cup. 70 mL.

How to get the best milk for your coffee

Fill your milk jug (pitcher) with *just enough* milk for the drink that you're making. This is not only economical, but will also make latte art easier and should help to alleviate the fear that many newbies have of the milk spilling on the floor as it rushes towards the lip of the cup. Usually, just below the start of the spout is the maximum fill level (Figure 6.2) as it gives you just enough headspace to spin the milk.

Figure 6.2 Maximum level for milk

Fill the milk jug (pitcher) to just below the spout.

Figure 6.3 Purging the steam wand

Purge the wand

Before you start to steam the milk, give the wand a blast of steam (Figure 6.3). This clears the wand of any milk that the previous miscreant left up the wand when he forgot to purge it, and will also clear any water in the wand. Steam condenses to water as it cools down, so if you've not steamed for a few minutes you may have water still up your spout. We don't want to add water to the milk, so get rid of it!
That's the end of the sample for this chapter. The rest of the book is at Coffeegen.

CHAPTER 7

Teas & Chocolate

Tea, tisanes and chocolate have been around longer than coffee, but are less well understood.

Tea Processing and Types

The coffee and tea connection

Antony Wild, author of *Coffee, a Dark History*, posits a theory that the Chinese practice of toasting tea leaves led to the roasting of coffee. Tea has been prepared and drunk in China from at least the first century A.D. Several of these tea preparations involve pan-frying the leaves before steeping them to extract the flavours and stimulants. This is similar to the Ethiopian preparation of *kati*, which uses the leaves of the coffee plant, so it is possible that either the Ethiopians or the Yemenis came up with the idea of pan-frying the coffee seed independently from the Chinese, but none of the several detailed chronicles of the Middle East by European explorers prior to Chinese visits mentions coffee. The first mention of tea comes from Giovanni Ramusio's *Delle Navagationi et Viaggi* (1550–9).

From 1405 to 1433, seven treasure fleets left China to trade with the lands bordering the Indian Ocean. The fifth voyage called at Aden in 1417 and the last, a fleet of more than 100 ships and 27,000 men, went as far as Jiddah in 1432. A fleet of 27,000 men sailing past the pier would distract the citizen of any modern city from their busy MyFace status updates, back then it must have felt like visit from another planet. The locals would have been keen to imitate the customs of the Chinese officers who drank tea and the treasure fleets were there to trade. After the fleet returned to China, Confucianist introspection took hold of the country and the Emperor Zhu Zhanj closed the Middle Kingdom's gates to the outside world.

Sufis are mystics who seek to be closer to Allah. They are known for their meditative devotion to Allah and have often sought out chemical assistance to sustain their devotions. Tea might well have been used by Sufis until the Chinese cut off all trade. Sufis from Yemen may then have sought out other stimulants to aid their meditations and, having exhausted all the plants in Yemen, crossed the sea to neighbouring Ethiopia to discover ***khat***, along with coffee. Legend indeed has it that a Sufi, Gemaleddin, travelled to Abyssinia in search of stimulants and discovered the locals drinking a tisane from the leaves. Gemaleddin then toasted in the manner of the Chinese and brought the plant back to Yemen. He had discovered that a drink made from the fruit of the plant's cherries, *qish'r*, tasted better and were more stimulating than the leaves. Then Gemaleddin, who also happened to dabble in alchemy, found that roasting the seeds of the cherry transformed them into something that had an overwhelmingly delicious aroma and was yet more stimulating than *qish'r*.

The archeological excavations at Zabid (Yemen's capital 13th–15th centuries), show that c. 1450, Sufis drank coffee from small bowls that resembled the Chinese porcelain tea-drinking bowls. Wild's theory of the origin of coffee roasting is plausible but the connection between coffee and tea is not the only reason tea should interest a barista. Tea is served in most of our cafes and, if we're going to serve it, we should serve it well.

Quality tea

Tea can be awesome. Tea is much easier to brew than coffee but, as with coffee, it is most often done poorly. And when I say "poorly", I mean "not the way *I* like it". Some people love their gumboot tea steeped until the spoon stands up in the cup by itself with heaps of milk and sugar. Pure teas range from the deliciously delicate to the potently oppressive. The varietal, process and preparation are all integral to the resulting flavours and tactile sensations.

As with coffee, most tea is a commodity. The majority of 'speciality' teahouses are owned by enthusiasts serving saccharine floral concoctions. However, the best teas can also be remarkable in their flavour and tactile sensations. But they ain't cheap. Some of the best teas can go for 1 USD per gram. There's also plenty of far more expensive tea that just isn't very good. Just like coffee, there are 'celebrity' teas that fetch an inflated price without the concomitant flavours that should go with it.

One of the best indicators of quality is the pick number. A plantation may have up to twelve picks a year. The first pick in spring is the best and commands very high prices. The second pick will typically get 50% the price of the first, and the third will get something like 10% of the first. There are actually very few places where we can get genuine 'first pick tea' outside of China and Japan. The trader would have to buy by sight and smell and to really know her tea to be sure she were really getting the good stuff.

Processing tea

Camellia sinensis is the species that most tea leaves come from. Green, pu'erh, yellow, white, oolong and black tea are all harvested from the same plant but are all processed differently. The processing of tea is myriad, but the following are the most common:

Heating

The tea is heated to denature the enzymes in the leaves. This prevents oxidation within the leaf. The heating is usually done by either pan-frying (nowadays, by machine drier at 120ºC) or steaming. The Japanese tend to steam because that's how it was processed in China when tea was first brought into Japan. The Chinese continued to experiment with different processing methods and now mostly pan-fry.

Withering

Withering means wilting and happens in an uncontrolled manner as soon as the tea leaf is picked. It's important to make this uncontrolled wilting short.

The process of 'withering' refers to the slow controlled reduction of moisture combined with piling to homogenise the moisture content. The stress of dehydration makes the leaf easier to roll and triggers enzymatic oxidation to produce sweet aromas. Withering can take place under the sun or in shaded, well-ventilated rooms.

Disruption

Time to disrupt the sample.

Chocolate

Third wave chocolate

Like coffee, most chocolate available in supermarkets is remarkable for its lack of flavour. Once you start tasting craft chocolate, you'll be amazed at the flavours possible. There are hundreds of varietals of *Theobroma cacao*, the species that chocolate is made from. As with coffee, different varietals have different flavour characteristics. This, combined with the processing, gives us the precursor compounds for chocolate.

Processing cacao

Harvesting

Most cacao varietals cannot self pollinate, so there will be several varietals in each plot. This makes single varietal chocolate less common than coffee, but not completely impossible to source. To get chocolate, we break open the cacao pods and take the beans (seeds, actually) out. The beans are surrounded with a mucilage that is similar in texture and flavour to mangosteen or *duku langsat*.

Fermentation

Anaerobic

Cacao beans need to be fermented rapidly after they are taken out of the pod. Traditionally this had been in stepped wooden boxes (Figure 7.17), however, some producers are experimenting with plastic and stainless steel containers. The first stage of fermentation is anaerobic and involves yeast and lactic bacteria breaking down the mucilage surrounding the beans. This usually takes two days and the beans will be left in a pile and covered with jute sacking or banana leaves.

Figure 7.17 Traditional fermentation box

Aerobic

After 48 hours, much of the mucilage will have drained away. The beans are pushed from the top box into the next box down and they begin the aerobic stage of fermentation. The yeast will have died in the high temperatures within the pile and increased aeration favours acetic bacteria that consume the ethanol, producing CO_2 and heat. Temperatures can now reach up to 50°C (122°F), which kills the seed embryo. The pile is turned every 12 hours to ensure adequate oxygenation. The beans go through a colour change from light brown through bright purple to dark brown (Figure 7.18). Once the beans are completely brown inside, which usually takes five days, they are ready to be dried.

Drying

Drying is typically done on patios, preferably covered, for several days until the beans reach 7% moisture content. The beans need to be raked several times a day to ensure even drying (Figure 7.19). Many producers now use mechanical driers and there's one research station in Malaysia using a huge microwave drier that gives quite good results.

Figure 7.18 Stages of aerobic fermentation

Figure 7.19 Sun drying patio and wide-toothed rake

Producing craft chocolate

Sorting

Most cacao beans are below the standard required for craft chocolate. The market for speciality cacao is just beginning. To get good cacao, roasters need to go to the source and trade directly.

As with coffee, sorting is an essential step in chocolate production. I've bought sacks of cacao and, after throwing away the defect beans, I've got ⅓ of a sack left. The remaining cacao makes really good chocolate, but it costs me much more than it should. However, some estates and cooperatives are starting to pay more attention to their own sorting, enabling them to sell the top grades at a premium.

Roasting

Like speciality coffee roasting, most speciality cacao roasters use roasters that are smaller than 60 kg. Unlike coffee roasters, most craft chocolatiers use ovens (Figure 7.20) to roast their beans. Craft chocolate tends to be roasted more lightly than large-scale chocolate. Beyond a certain roast level, the cacao becomes more bitter and, unless we're trying to mask defects, there's no gustatory point to roasting so dark.

That's the end of the sample. The rest of the book is at Coffeegen.

Figure 7.20 Oven roasting cacao beans


THE COFFEE ROASTER'S COMPANION
THE WORLD ATLAS OF COFFEE
JAMES HOFFMANN