



Vanessa Kimbell

THE SOURDOUGH SCHOOL

THE GROUND-BREAKING GUIDE TO MAKING
GUT-FRIENDLY BREAD

PHOTOGRAPHY BY NASSIMA ROTHACKER

KYLE BOOKS



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How to use this Ebook

Select one of the chapters from the [main contents list](#) and you will be taken to a list of all the recipes covered in that chapter.

Alternatively, jump to the [index](#) to browse recipes by ingredient.

Look out for linked text (which is in blue) throughout the ebook that you can select to help you navigate between related recipes.

You can double tap images to increase their size. To return to the original view, just tap the cross in the top left-hand corner of the screen.

Foreword

by Richard Hart

I haven't always been a baker. I started my career in baking at the age of 30 and it quickly became an obsession – an obsession that drove me from never having made a loaf of bread to being Head Baker at Tartine in a matter of years. Now I have gone on to partner with Noma, and I am in the process of opening my own Hart's Bakeries to share my knowledge and love of sourdough.

I first met Vanessa while still at Tartine, when she came to interview me about sourdough for BBC Radio 4's *Food Programme*. It quickly became clear that Vanessa shared my obsession, and we speak often, talking bread and techniques. We also share a belief that great bread is for everyone.

The art of bread baking takes time, dedication and practice. You can't just follow a formula; you have to develop an understanding with your bread. Sourdough is a living thing, it's challenging and requires love and care. It's influenced not only by the environment in which it's made, but where the ingredients are grown, and as a baker you need to pay attention to every detail.

In this book Vanessa gives you the tools you need to be a successful baker. If you take this knowledge and focus you will be rewarded with beautiful, freshly baked bread. Making sourdough is addictive and there is nothing better than pulling a handmade loaf out of the oven.

Making bread using a sourdough starter also gives you better bread. The texture and flavour are far superior to that of a yeasted loaf. Sourdough bread is also fundamentally better for your body. The bacteria in the sourdough help break down the flour, which makes it more digestible and nutritious. Vanessa has a unique understanding of this process, which she shares with you here, and the fact that sourdough bread is more nourishing.

This book is interactive. It shouldn't just be followed like a regular formula book. You should pick it up and read it thoroughly and use it as a series of steps to help you best understand your own environment and flour. It's not easy. You need to be completely aware of your ingredients and surroundings, to pay attention to your starter and dough and listen to what it needs. You will make mistakes and constantly question yourself. Every time something went wrong with my bread, I took it as an opportunity to learn and succeed. This book and the sourdough loaf records will help you do the same.





My sourdough story

My first memory of sourdough was aged nine. We'd been travelling to Dordogne for about 14 hours. As we approached the village that was to become the place we spent my remaining childhood holidays, I looked out of the car window: there was a fortress-like church with a huge bell, which was surrounded by fields full of fresh green grass, cowslips and gnarled old walnut trees. We stopped at the hotel restaurant and I got out of the car. I remember how happy I was as we were brought potage and baskets filled with hunks of fresh cut bread. It was so different from the bread in England. The crumb was chewy and tasted lightly sour and the crusts were as rugged as the bark of the walnut trees. At that moment I fell in love.

It turned out that the bakery was just yards from our house, and so by the time I was 11, I was working in the local bakery. I'd sweep up, knock out and stack up the bannetons (wicker baskets), brush down the loaves as they came out of the oven and serve the customers. I was often given some dough to shape and allowed to bake it. Everyone from the village, rich and poor alike, bought their bread fresh every morning. I knew everyone, and everyone knew me.

I'd leave the bakery mid-morning and take the bread to the restaurant, where I would help Angelique in the kitchen, stirring the soup, fetching butter from the farm, stoning wild plums for tarts and feeding the carrot tops to the rabbits. As I got older, I would waitress, often serving the same people I'd served in the bakery earlier in the day. After lunch, I'd carry the previous day's bread in a sack back to my friend Noel's farm and feed it to the pigs.

Back in the UK I left school and trained as a chef and baker then, at the age of 18, I returned to France and promptly fell for a handsome Frenchman from the local village. His father got me a job as an apprentice in the local town bakery where I stayed for a year, baking sourdough, brioches, tarts and patisserie. It was amazing, but the hours were long and the pay minimal, and I wanted more, so I returned to the UK thinking I would put my skills to use in a British bakery. But in the early 1990s finding somewhere where they baked sourdough was almost impossible. I was literally laughed out of one bakery when I explained how we fermented the dough using old dough from the previous day, otherwise known as *pâte fermentée* or pre-ferment.

Instead I found freedom working early shifts in a hotel making French patisseries. I was finished by 9am, so in the day I went to university. I didn't sleep much at the end of my last term at university and I became ill. I was given large doses of antibiotics, after which, at the age of 24 and to my total dismay, I could no longer digest any wheat. The doctors couldn't explain why, so I stopped baking, changed career and followed a gluten-free diet for almost four years. It was miserable.

During this time I'd avoided France because bread was everywhere, but in 1998 I returned to show my now husband my French home. As I walked past the bakery on my first day back, I smelled the freshly baked bread. Hervé the baker was so happy to see me that he pressed a warm miche (pain de campagne) into my hands. It smelt so good. I found myself moments later at the kitchen table, oblivious to the rest of the world, devouring half the loaf in one sitting. My husband walked into the kitchen to find me sitting in a pile of crumbs with my head in my hands as it dawned on me that I was going to be ill... very ill. I braced myself for what was to come: asthma, joint pain, a foggy head, tiredness, irritability, bloating, eczema and digestive issues. But, to my surprise, I wasn't ill. I was fine. I spent the next two weeks making up for lost time eating as much bread as I could. It was heaven. When I got home to the UK I went out, bought a loaf of bread, ate it and was promptly ill. It was then that I realised that the bread I had grown up eating in France was digestible, but the commercial bread I was eating in the UK was not. In that moment the direction of my life changed and I decided that I had to understand what was so different about sourdough.

As I began teaching I figured that if I was to look after my students in the best way possible I needed to know whether they had any health issues. I devised a form for the course bookings, which helped me to discover more about the health of my students. What soon became apparent was that specific health issues kept cropping up – diabetes, IBS, Crohn's disease, diverticulitis, gluten sensitivity and cancer. The students often had questions of their own; they came to me for more than just a formula. People wanted to understand sourdough and to explore how it could contribute to their health and well-being. Increasingly, I realised that many people had the same questions I had. Why is sourdough easier to digest? As I began to talk about bread and digestibility, more people opened up about their digestive issues. There was never a class when someone didn't mention problems with digestion, and this raised more questions.

I started asking other bakers and healthcare professionals, but as no one was able to provide me with answers I realised I was going to have to find the answers out for myself. I began to read every scientific paper I could find and talked to microbiologists, gastrointestinal specialists, oncologists and nutritionists. What quickly became apparent was that the fermentation is transformative and the actions of the microbes have an extraordinary ability to change flour and water into something more nourishing and digestible.

The research also brought the role of other microbes to my attention. One research paper showed that some of the microbes in a starter originated from the soil when the wheat was grown organically. At the same time I discovered that we have our own gut microbiome, and that having robust and diverse gut microbes is essential to our health. We are symbiotic with many of the same microbes. When you add in the process of fermenting bread you complete a microbial circle from soil to our own digestion and health. The long, slow fermentation and acids produced by the lactic acid bacteria transforms flour to make a bread which is not just food for us, but provides sustenance to our microbes – sourdough is a prebiotic. It is astonishing. We are connected on levels that we are only just beginning to understand. In my determination to understand this incredible, transformative process, life has brought me full circle and I am now chatting again to doctors about bread, only now it's about the School's nutrition and digestion of bread course – a course which has been accredited by the Royal College of General Practitioners.

So this book is far more than just a collection of formulas, it is about answering those questions, understanding sourdough and sharing the knowledge of why this magical fermentation process is integral to making the most nourishing and delicious bread in the world.





How to use this book

This book isn't about my bread. It is about your bread. I know my kitchen, I know my flour and I understand the timings and process.

This book is about your bread, your kitchen and your flour, and so to get the very best results I have designed this according to my kitchen and the flour that I use here. To succeed you will need to plan. You can use my plan to begin with but your flour and kitchen are different from mine so follow my example and then adjust timings and temperature accordingly.

1 Read the book before you start baking. Boring, I know, but you need an overall understanding.

2 Make sure you have all the [equipment](#) required.

3 Start with the first formula (see [here](#)) and work your way forward. The formulas are in order of difficulty.

4 Go to and choose which [method](#) you want to use, either ambient (all in one day) or retarded (overnight in the fridge) according to your timings and taste preferences.

5 Go to and plan the [schedule](#) in conjunction with the formula.

6 Use the [step-by-step](#) chapter which gives detailed information on how to make your bread.

7 Record the timings and temperatures on [your loaf schedule](#). You can photocopy this from or download more from [sourdough.co.uk](#).

8 Analyse the results and celebrate each loaf. Make notes on any adjustments you need to make. The more you bake the better you

will get.

Repeat.

Often.

Flour, water & salt + Culture, warmth & time = Sourdough

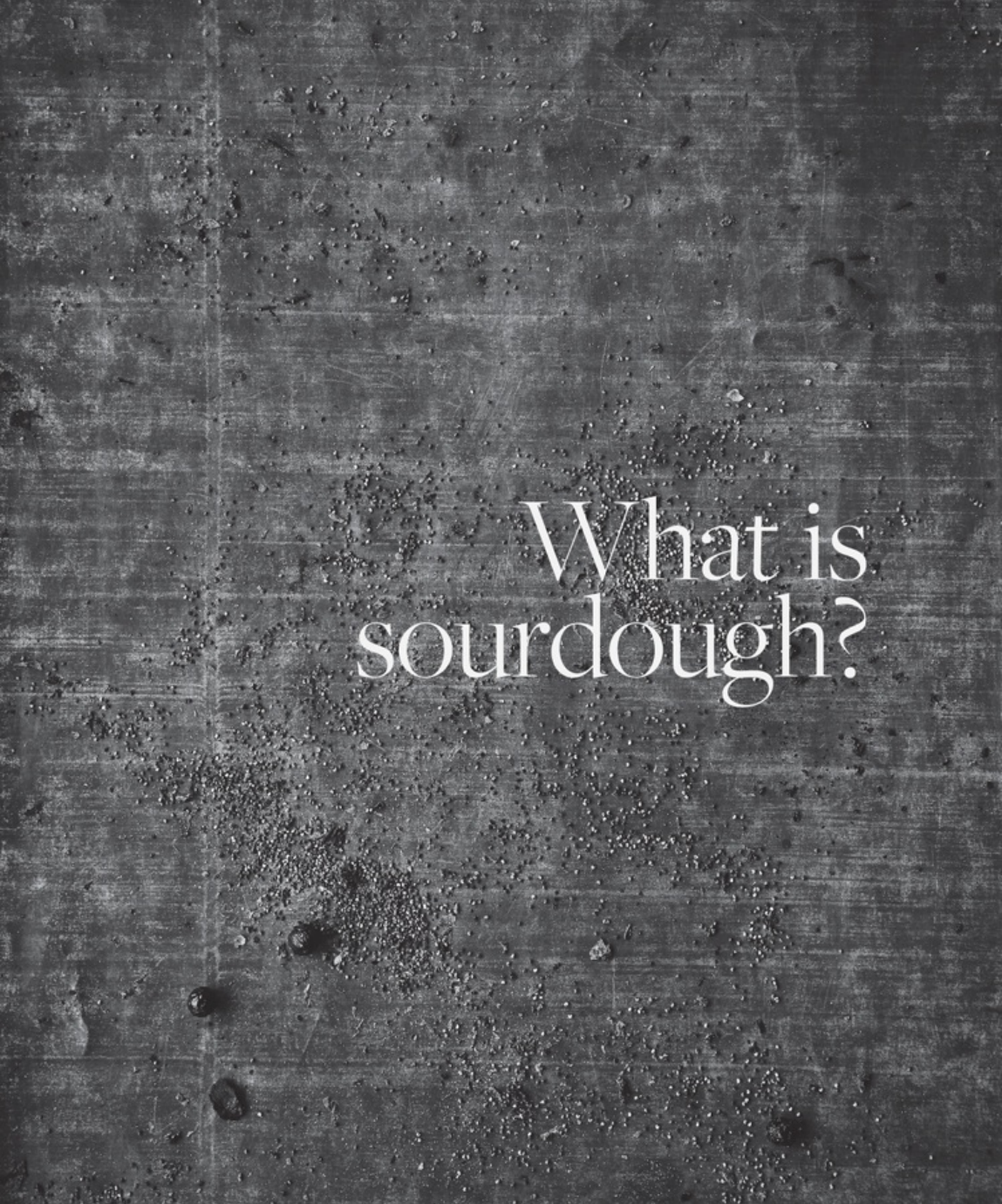
This is not just a recipe book; my aim is to challenge you to think about bread differently, because in spite of our ever-changing world, with its advances in modern technology and pressures to have everything done in an instant, bread is still the staff of life, something that every culture in the world has in common.

Sourdough is the oldest way of making bread, and uses naturally occurring wild yeast and lactic acid bacteria. It produces bread with a distinctive taste, but it is about far more than amazing flavour and nutrition. The process of baking sourdough is sensuous and nurtures both mind and body, and requires a thoughtful and spiritual approach. Artistic and scientific, it is a combination of passion, patience, dedication and craftsmanship. It is about connection, using hands, touch, smell, taste, sight, heat and mind. These elements, which have been largely lost in the drive to make bread a commercially produced product, are not independent of each other; they are the cornerstones of sourdough. All of the formulas in this book are hand mixed, none are machine mixed.

The best bakers don't just blindly follow a formula. They use their senses. But before you can do this, you need to become familiar with the process, to the point where it becomes instinctive. You need to practise, in much the same way musicians practise their instrument until playing it becomes second nature. Making sourdough takes more than just an ingredients list and a method. It means connecting with what you are doing and getting to know the dough. The more you bake, the more familiar it will become. Good bakers bake often, and one of the best pieces of advice is to make more than you can eat: give your bread away. Find friends and neighbours to share your loaves with.







What is sourdough?

Sourdough is bread made from flour, water and salt and fermented using lactic acid bacteria and wild yeast. It is universal. The French call it levain, the Italians lievito naturale. The Russians say zakvaska, in Poland it's zakwas, Germans call it sauer Teig and in Denmark it's surdej. Spanish and Hispanic countries call it masa madre.

Sourdough is used as both a verb and a noun. It is a word used to describe a process of fermenting flour, water and salt to make bread. The same word is used when talking about the bread.

Bakers culture and nurture a colony of symbiotic microbes in a pot of water and dough, this is called a starter. Some people love their starters so much they name them like members of their family. Some go back generations, and are absolutely integral to daily life. Others are cultivated by home bakers and occasionally emerge from the fridge, with the baker feeling guilty, like trying to revive an abandoned science project.

The key thing to understand is that this culture is alive. Inside the pot is wild yeast and lactic acid bacteria. The lactic acid bacteria (LAB) produce organic acids that acidify the dough and transform the taste, nutritional value and digestibility of the bread. It is predominantly the yeast that produces CO₂ that makes the bread light and airy, but it also makes other products that contribute to flavour.

The microbes in the pot work together and the acid also provides protection to the acid-tolerant yeast cells from other competing microbes, so they can get busy producing enzymes, processing flour and reproducing in peace. The enzymes are the key to breaking down the flour. There are lots of them, including amylase and maltase enzymes that break down the polysaccharides (a type of sugar), the complex starches in flour and the maltose into simple sugars (glucose), making food available to all of the microbes, including the LAB. The yeast then produce another enzyme called invertase, which breaks down sucrose into glucose, fructose and zymase. This in turn facilitates the fermentation of sugar into CO₂, raising the dough and ethanol, which is involved in the formation of esters which flavour the bread. The lactic acids also contribute to kick-starting production of enzymes called phytates which break down phytic acid, making the bread more digestible and unlocking the nutrients, making it more nourishing. There is more on this in the digestibility and [nutrition chapter](#).

A starter needs to be replenished and maintained to ensure that the activity of the microbes is managed. We refer to this as refreshing the starter.

For most people, the properties of wild yeast and LAB are an enigma; they just know that they flourish when maintained and make great bread.

However, as I explain later, different LAB produce different acids. These contribute to the variety of flavours and textures in sourdough. Some bacteria produce more acetic acid, others more lactic acid. The flavour and texture of your bread also depends on the kind of flour, the dough temperature, and length of fermentation.





How sourdough works

There are some studies that indicate that the yeast and the bacteria have a mutually beneficial, inter-dependent relationship, sharing the available nutrients from the flour. Rather than compete for food they act in partnership to protect their ecosystem from other uninvited bacteria. That said, it is actually more complex than this. There is generally one dominant yeast and several lactic acid bacteria (lactobacilli or LAB). Perhaps a better way to understand sourdough is that bacteria are single-celled organisms and, lacking stomachs, they use enzymes to break down their food on the outside – in the dough.

I sometimes explain that sourdough starters are private members' clubs for microbes. As they produce acids as well as producing the unique flavours and textures of sourdough, the LAB are responsible for the increased acidity of the dough, which is one of the main reasons why sourdough is more nutritious and more digestible (see [The health benefits of sourdough](#)). They can be found in sourdough that has been slow-fermented at a bacteria-to-yeast ratio of 100:1. The yeasts – oval, one-celled fungi that produce carbon dioxide (CO_2) when they have access to oxygen through aerobic fermentation – are much bigger. They are the bubbles that you see in the bread dough, and are what makes your bread rise.

The job of the sourdough baker is to control the acidity variations of the dough through time, temperature, measurements and the leavening, as the level of sourness affects the gluten structure, flavour and crumb. So it is useful to know where the acids come from and what they do. Understanding the micro-organisms puts the baker in control of the baking process. The LAB break down the flour by the actions of enzymes, that in turn break down the starches into simple sugars. These sugars are then consumed by the microbes, which then produce both lactic and acetic acids that continue to break down the flour.

As the microbes produce acids, the pH of sourdough changes according to the stage of fermentation, but in general it has a pH of 3.5–5. It is this acidity that stops the development of pathogenic microorganisms such as *Clostridium botulinum*, *E. coli* and spoilage fungi, as they are unable to reproduce in an environment with a pH below 4.6. As well as producing these organic acids, the bacteria also produce exopolysaccharides, a kind of 'sugar slime', in which they like to live. This slime has two main benefits: firstly it provides a structure and changes the 'mouthfeel' of the bread, and secondly it provides food for our gut microbes.



The symbiotic relationship

Sourdough is a culture that relies on the relationship that exists between the lactic acid bacteria and wild yeast. In one of the earliest studies of the leavening action of sourdough by two researchers, Sugihara and Kline, conducted in the early 1970s, the principal yeast they found was *Candida milleri* (now known as *Candida humilis*) and the dominant lactic acid bacteria was *Lactobacillus sanfranciscensis* (a heterofermentative *Lactobacillus* species meaning that it produces more acetic acid). Unusually for yeast, *Candida milleri* likes to eat glucose and fructose, and is more tolerant of the predominantly acetic organic acids that *Lactobacillus sanfranciscensis* produces. *C. milleri* also doesn't digest maltose, which the *L. sanfranciscensis* loves.

This is a great example of how the microbe's choice of 'food' affects the kind of bacteria that it hangs out with and it explains why San Francisco sourdough is more sour. In simple terms, the *L. sanfranciscensis* has more 'food' and so it produces more acetic acid, therefore the resulting bread is more sour. This is just one example of one starter – we are just beginning to understand these relationships and we are learning that each sourdough starter culture has its own combination of individual microbes, and each colony is unique to its environment. There are many different combinations of bacteria and yeasts, all producing slightly different flavours, which become even more diverse when bakers start getting creative with their flour. Although there are sometimes several different kinds of yeast and bacteria in a starter, usually there is one dominant yeast and several more species of LAB.

What is clear is that the mix of microbes and yeast also depends on what the microbes break down and what they then extract as food from the flour. Available 'food', in other words, determines which microbes group together to form non-competing, symbiotic microbial clusters of species. Depending on the point in the process, some species compete with others for food. It is not quite so straightforward when there is both cooperation and competition at different stages of the fermentation process.

A sourdough starter is unique

At the Sourdough School I've seen and tasted starters from hundreds of bakers. Although they share characteristics, I am constantly astonished by the incredible diversity of flavours of both the starters and the sourdough breads. The idea that you can create an ecosystem in a pot that

behaves differently according to the conditions in which it lives and how it is nurtured is fascinating.

Research certainly seems to indicate that microbes in the pot are determined by environmental factors, including the flour, the soil in which the grain is grown, the environment in which it is kept and wild yeasts in the air. I believe, however, that there is another influence in determining which microbes end up in starters. The cultures are nurtured by human hands, and I think that this interdependent relationship with the baker is the missing part of our understanding of where the microbes come from. In other words, the lactic acid bacteria in each baker's pot might well be influenced by the lactic acid bacteria from the baker's own skin microflora.

There were no studies on this as I began to write this book, but as I type these words there is an amazing large-scale research project being carried out by Rob Dunn Laboratory looking into understanding more about cooperative microbial communities and how their bacterial relationships work. So my theory that there is a possibility that starters are symbiotic with the baker and their skin microflora will soon be better understood. During my investigations I looked for more evidence of this relationship so I had my own gut microbiome tested. There were absolutely no common microbes. I was somewhat disappointed, but as a friend pointed out, perhaps it was a good thing when you consider those might have ended up in the pot!





Baking sourdough is as much about connecting to your ingredients as it is to the bread itself. At the school we try to use as much produce as possible from our organic garden, where we have an abundance of herbs, a walnut tree and fruit, including blackberries, blackcurrants, apples, pears and apricots. The starting point for all ingredients, however, is the soil. My research into the subject has convinced me that we are part of a system that connects our well-being directly to the earth. It is a web – the soil is full of microbes, a sourdough starter is full of microbes, our digestive systems are full of microbes.

I'm often asked where the microbes in the starter come from. We know that the wild yeast and lactic acid bacteria hang out on the wheat itself, and one of microbiologist Marco Gobetti's most interesting studies followed the life cycle from plant to flour. His team at the University of Bavi looked at different farming practices and the way in which soil is fertilised (or not) to see which method promoted the growth of bacteria on the wheat. The team grew durum wheat on the same farm using four different farming approaches:

- **conventional (standard fertilisers and pesticides)**
- **organic with cow manure**
- **organic with green manure**
- **organic with no inputs**

Even before the sourdough was fermented, there were differences in the composition of microbes in the flours. That derived from wheat grown in a conventional way had a higher amount of LAB from the genus *Leuconostoc* (19 %). After the sourdough fermentation, there were still differences. The flour derived from wheat grown using green manure had the highest amount of *Lactobacillus* and that from the flour grown using the no inputs treatment had the greatest amount of *Leuconostoc*. The wild yeasts, however, were not affected by the farming method, and several species of yeast, including *Saccharomyces cerevisiae*, *Candida humilis*/*Kazachstania barnettii* and *Saccharomyces bayanus*/*Kazachstania* species or spp., were found in sourdough made using all four flours.

This study was the start of understanding that growing wheat by organic methods with the application of manure is a source of microbes that make it into sourdough. In fact, there are more microbes in a teaspoon of soil than there are stars in the sky.





Why organic?

In 2013, Friends of the Earth Europe commissioned an independent laboratory in Germany to test people in 18 European countries for glyphosate, a herbicide routinely used on wheat. The results showed traces of glyphosate in an average of 44% of people, though in the UK 70% of people had traces of this weed killer in their urine. Dr Robin Mesnage of the Department of Medical and Molecular Genetics at King's College London recently published a paper on the formulation of Roundup (the commercial name of glyphosate-based herbicides). He said: 'Glyphosate is everywhere throughout our food chain – in our food and water. The lack of data on toxicity of glyphosate is not proof of safety and these herbicides cannot be considered safe without proper testing. We know Roundup contains many other chemicals, which when mixed together are 1,000 times more toxic than glyphosate on its own.'

What I find particularly alarming is that worldwide usage of glyphosate has increased more than 20-fold since 1990, according to the Center for Biological Diversity, Tucson, Arizona. The conservation advocacy group says this upsurge is largely due to the widespread use of genetically engineered 'herbicide tolerant' crops, particularly wheat and soya, which can withstand an otherwise fatal dose of glyphosate. In 2013 the Soil Association reported that nearly a third of UK cereals were sprayed with glyphosate, a total of just over one million hectares. Figures from government data analysed by the Soil Association, which is calling for a UK-wide ban on the use of glyphosate, were released at a scientific briefing in London on 15 July 2015. These revealed that in the last 20 years the use of glyphosate in UK farming has increased by 400%. Furthermore, it is one of the three pesticides regularly found in routine testing of British bread, appearing in up to 30% of samples tested by the Department for Environment, Food & Rural Affairs. The levels are well below the Maximum Residue Level (MRL) set by the EU, but a ban cannot come soon enough for me because the truth is that no one can say with certainty whether glyphosate is safe because long-term trials have simply not been done. The evidence has been drawn mainly from studies of agricultural exposures. Other evidence, including from animal studies, led the World Health Organization's International Agency for Research on Cancer (IARC) to classifying the pesticide as 'probably carcinogenic' in March 2015. Research also indicates that chronic, low-dose exposure to glyphosate can cause liver and kidney damage, another serious concern apart from the decline in numbers of many pollinating insects that may be caused by spraying glyphosate.

The plant

Triticum aestivum, or bread wheat, is the most widely grown of all crops and represents about 95% of all wheat grown. A golden field of wheat with the wind sending rippling waves through it is a beautiful sight to behold. We grow it in order to harvest the seeds, which are then ground into flour, though the grain itself grows with the intention of landing on the soil, getting damp and sprouting. The parent plant gives the seed everything it needs to do this: energy, which it stores as protein, and enzymes to break this down into easily accessible sugar; it is also packed with minerals and vitamins. Surrounded by a protective outer husk (the bran), this seed sits and waits for the perfect moment when water unlocks its potential.

When we harvest these grains and grind them into flour the organic reactions remain the same, and as the enzymes break down the starch into sugar, so the lactic acid and wild yeasts benefit from the transformative abilities of the many enzymes. If you think about flour in this way, the whole sourdough process makes more sense. It reacts as though it is about to grow into a plant as you add the water.

Flour

To become a really good sourdough baker, you need to become familiar with your flour. All too often bakers who lament their inability to create the bread they want change their flour on an almost bake-by-bake basis. I often compare baking sourdough to playing a musical instrument. You can't start off learning to play all the instruments in the orchestra; you have to pick one, learn it and then master it before you can do anything else. Likewise, the more familiar you become with one particular type of flour, the more you will understand its nuances. You'll see and feel how it begins to transform, and how it responds to different temperatures and different inclusions. Once you've become familiar with a particular type of flour, baking becomes much more instinctive. Then, when you move on to new flours, you'll find yourself able to bake with the understanding that

comes from really knowing how the dough should feel and you can adjust accordingly.

YOU NEED TO USE A STRONG WHITE BREAD FLOUR WITH 11–13% PROTEIN FOR THE BASE OF MOST OF THE FORMULAS IN THIS BOOK

The flour you choose will affect absolutely everything about your bread from the flavour down to the crust, crumb, texture and rise. It always surprises me when I talk to bakers and they don't know where their flour comes from – and I don't just mean which mill or shop. I mean which field was the wheat grown in, which country, and how was it treated and by whom? A healthy plant will give you a better flour, so you need to know if it had access to nutrient-rich soil and whether the wheat was sown too closely together. Plants that were not sown too closely together will have a much deeper network of roots and will stand strong in the soil. It is via these deep roots that the wheat absorbs the nutrients it needs to grow.

Your flour – and therefore its level of gluten and how it behaves – is also affected by the variety of wheat the farmer has chosen to grow and the terroir in which it grows. Rather like roses in the garden, grain comes in many different varieties, all of which will have different perfumes, flavours and textures. And, of course, sunshine is vital. In areas of higher sunshine, the wonderful warm rays produce a better quality protein. Protein itself is an energy storage unit for the plant so the more energy it gets from the sun, the more storage units, i.e. higher levels of protein.





LONG SLOW FERMENTATION IS A WONDERFUL WAY TO COAX THE MOST FLAVOUR OUT OF GRAINS

A guide to grains

BARLEY There are records of barley being used to make bread and beer in ancient Egypt, and Roman gladiators were known as 'hordearii' or barley-eaters, in reference to the fact that their diets comprised large amounts of grain. Early farmers in the Fertile Crescent would have grown it alongside other ancient grains such as emmer and einkorn. It also grows well under cool conditions, making it well suited to more temperate areas and in countries where the climate is less favourable for wheat cultivation. It's high in fibre, low in gluten and a good source of B vitamins, minerals and protein. Barley has a variety of uses in bread making, either ground to make a flour, or added to the dough as a sprouted grain or richly flavoured malt extract. Barley is also a key ingredient in beer making and distilling. With a wide geographical spread, and thousands of years of domestication, there is now a range of barleys in cultivation. Bere is a six row variety of barley, cultivated in northern Scotland and traditionally used to make bannocks. Two-row barley is used in beer making and black barley, originally from Ethiopia, is a tasty and highly nutritious ingredient.

BUCKWHEAT Another grain high in fibre, which therefore acts as a good prebiotic, which has also been shown, especially when germinated, to produce lower GI responses. Its prebiotic properties have positive implications for obesity and improving the gut microbiome. At the School, we use buckwheat as a porridge.

DURUM This is the only tetraploid [contains four sets of chromosomes] species of wheat of commercial importance that is widely cultivated today. Durum wheat flour is high in protein, however it lacks strength and so is often supplemented with refined wheat flour to offset its poor gluten network.

Interestingly, heritage durum wheat grains are often much more delicious than modern ones and in some cases they have higher levels of antioxidants. There is also evidence that the levels of healthy plant sterols (molecules associated with lowering cholesterol) are actually higher in tetraploid wheats like durum than in hexaploid wheat varieties (modern bread wheat) so they are beneficial for heart health.

EINKORN This ancient wheat is a diploid variety, meaning it contains two complete sets of chromosomes, one from each parent. Like most heritage flours, it is incredibly flavoursome, being rich, nutty and sweet. While it has low gluten levels, it is still a good source of protein, iron, dietary fibre, thiamine and other B vitamins. It also contains a significant amount of the powerful antioxidant lutein, which makes it higher in antioxidants than durum and bread wheat. As it has remained unaltered for thousands of years, many people with gluten sensitivity report that they can eat it without an adverse reaction.

There is some evidence that einkorn has higher levels of phosphorus (phytic) compared to durum and hard red spring wheat, so although it is reported as being easier to digest, einkorn really needs a long, slow fermentation to neutralise the phytic acids for anyone suffering from IBS (see [The health benefits of sourdough](#)).

EMMER A heritage Italian wheat (called farro in Italy) that has been around for more than 2,000 years. The husk keeps the grain's nutrients intact long after it has been harvested, so every serving contains rich amounts of nutrients, including large amounts of fibre, vitamin B3 and zinc. It is also a rich source of iron with 110g containing 24% of the recommended daily intake.

FREEKEH A cereal grain made from green young durum wheat that is roasted to create a nutty flavour. Freekeh is an excellent source of fibre and protein. It has double the amount of fibre of brown rice and three times more protein than quinoa. It is also low on the glycaemic index, making it an ideal grain for diabetics.

KAMUT®/KHORASAN Kamut® is the commercial name for khorasan, an ancient wheat species with origins in central Asia. Golden in colour, it is full of carotenes and selenium and has a rich, buttery texture and complex flavour. It is a good alternative for people with type 2 diabetes as

research shows it helps to reduce glucose and insulin levels.

OATS Oats contain beta-glucans, powerful soluble fibres found in the oat's cell walls that lower cholesterol in the body by preventing it being absorbed from the gut into the bloodstream. Beta-glucans also decrease the body's rate of starch digestion to keep blood sugar levels steady. One six-year study of more than 65,000 women found that dietary fibre actually prevented type 2 diabetes from developing. In fact, 4g oat beta-glucans can lower glucose levels – by incorporating oats in their diet, some diabetics have seen a drastic improvement in their blood sugar levels. In another study in Norway, ten people were fed 60g porridge a day and found that within a week their gut microflora had improved. At the School we use oats for [porridge](#) in the sourdough, a suggestion for which I have to thank Richard Hart. I love adding porridge to bread because it gives the most amazing texture, but the health benefits are also impressive.

RIVET WHEAT A heritage grain milled from a rare species of wheat (*Triticum turgidum*) which is absolutely delicious. It was first grown in England in the Norman period and became popular because of its high yield and nutty flavour. Flour from these grains has less protein than others. Rivet flour (100%) could be a suitable alternative to wholegrain for those with non-coeliac gluten sensitivity, and is one I recommend trying as 20% in the classic formula as it is a heritage grain.

RYE Has a distinctive, deep flavour. It is thought to have originated from a wild species that grew as a weed among wheat and barley fields. Sourdough breads made with rye are more compact and dense; its gluten is less elastic than wheat so it holds less gas during the leavening process. Since it is difficult to separate the germ and bran from the endosperm, rye flour usually retains more nutrients, including higher amounts of fibre and phytonutrients, than wheat.

SPELT This ancient grain is part of the same family as wheat, rye and barley. Spelt is more easily digestible than wheat because of lower levels of gluten and higher levels of soluble fibres. Although the nutritional content of spelt is similar to wheat, it has almost double the amount of vitamin K (required for normal blood coagulation and optimum calcium absorption). It also contains several minerals including iron, potassium and zinc, making it more nutritious than wheat.

WHEAT Wherever possible I try to use wholewheat grains. They contain both the bran and the germ and are a high source of [fibre](#), polyphenols, vitamins and minerals. The long fermentation of sourdough increases the bioavailability of these beneficial components, making a more nutritious loaf compared to yeasted bread.

Gluten

Gluten is a protein that builds the network that keeps your dough together. It binds the starch almost like a web of elastic bands that runs through the bread, allowing the starch to gelatinise and stay in place. It works a bit like a balloon, capturing the carbon dioxide that comes off the microbes as they ferment the sugars in the flour, i.e. one with more protein content. You don't need very strong flour to bake great sourdough. Generally, I work with flour with about 11–13.5% protein. Occasionally I use a higher gluten flour to support lower gluten ones and use it to blend.

Fermentation

The flour you use also dictates, to a large extent, the speed of fermentation. Flour contains amylase, an enzyme that breaks down carbohydrates into sugars that the yeasts can access. A flour's enzyme levels will depend on where in the world it was grown. British flours tend to have high levels of naturally occurring enzymes because they are grown in a maritime environment. This results in high levels of enzyme activity, which means that dough ferments more quickly, yeasts are more active and more carbon dioxide is produced, making the bread more bouncy and voluptuous. You will sometimes find flours that have had enzymes added to them – flours from the USA, for example, tend to have less naturally occurring enzymes so millers make adjustments using malt and alpha-amylase to get the liveliness and activity needed.



STRETCHING AND FOLDING DURING THE BULK FERMENTATION HELPS DEVELOP THE GLUTEN NETWORK

Milling methods

The next thing to think about when choosing flour is the type of milling method used, because this makes a huge difference to your bread. When wheat is processed, the grain is crushed, milled and then sifted to remove the germ and the fibrous outer layer. Traditionally, flour was stoneground, but the modern milling process uses steel rollers. These rollers are very efficient at separating out the component parts of the grain, but they also get hot, which significantly reduces the number of wild yeasts and lactic acid bacteria that might be present in the flour.

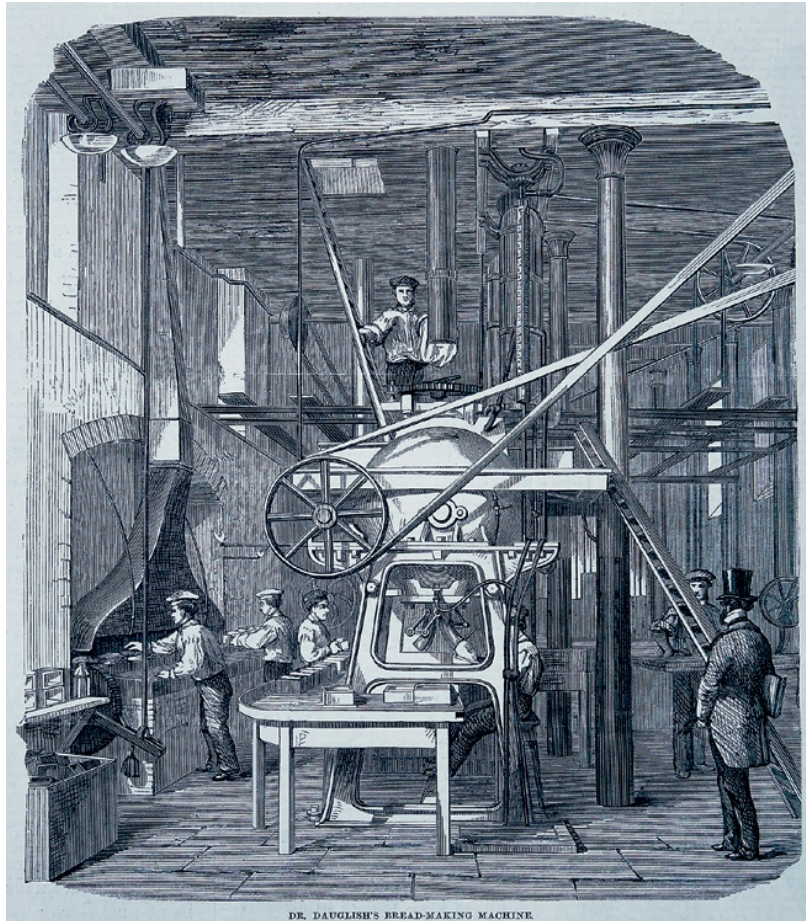
All flours have an extraction weight, which is the percentage by weight that is extracted from the whole grain to make flour. You might assume that wholegrain flour contains 100% of the grain, but this isn't always the case for highly processed flours. White flour still has very high levels of extraction – which can be up to about 70% – but what's left after the roller-milling process is pure endosperm or starch – the interior of the grain. As a result, white flour contains much lower levels of the micronutrients concentrated in the outer layers of the wheat germ (the aleurone). If you compare two white flours with a 70% extraction rate, one stoneground and one roller-milled, the stoneground one will still have some nutrients in it, but the roller-milled white one will have almost none. This means that some of the nutrients, such as calcium carbonate, thiamine (vitamin B1) and iron, often have to be added back in in the UK, but not in all countries. Not in France, for example.

The 40% of the grain that gets removed to make white flour includes the bran and the germ. These are the most nutrient-rich parts. In the process of making 60% extraction flour, more than half the vitamins and minerals are lost, including B1, B2, B3, E, folic acid, calcium, phosphorus, zinc, copper and iron, not to mention fibre. Despite this, organic roller-milled white flour can be an incredibly useful ingredient to blend with other flours, particularly if you want to add lightness to the texture of sourdough. I use strong white roller-milled flour almost as scaffolding, to add strength and to give a robust structure to my breads, and sometimes to slow things down, especially lower or non-gluten flours. However, I would never use 100% industrially milled flour on its own to make a loaf – not only is it lacking the key nutrients and fibre I want in my bread, but I find its flavour too flat, with none of the complexities of wholegrain flour.

Milling your own flour

I love using freshly milled, wholegrain flours in virtually every loaf that I make, so much so that I have a collection of my own stone mills. When I use freshly ground flour my breads have a subtlety and a richness of flavour that is an absolute knockout. There is a layer of wheatened 'perfume' when you mill flour that elevates sourdough to another level of deliciousness. Commercial flour is all milled to the same specification. With your own mill, you can mill the same grain as coarsely or as finely as you want. This adds texture and effectively adds another dimension to your bread.





I have several mills at the School. I love playing with the rough finishes that you can get using the hand mill – it is an ideal teaching tool because it's slow and considered. If you are in a hurry, a kitchen-top Komo mill has its advantages; flick a switch and you are milling. The Mockmill is a lovely little attachment designed to fit a KitchenAid and is a delight to use. If you already own a KitchenAid then do consider getting a Mockmill – it's small, easy to use and mills brilliantly. The main reasons for milling your own flour are flavour, flavour and flavour. Stoneground flour contributes significantly to increased flavour in slow-fermented breads. You get nuttiness, malt flavour and the sweet floral notes of dried meadow herbs, warming porridge and toast to name just a few of the flavours found in wholegrain sourdough. The higher levels of nutrients and the bran in wholegrain accelerate fermentation and production of by-products increasing acids and the metabolites including iso alcohol, ethanol, keytones and esters, and that brings wonderful complex flavours to the bread.

In terms of nutrition there is no doubt that wholegrain flour is more nutritious when fermented with sourdough. We explain more about this later in the book as sourdough increases the bioavailability of the nutrients in bread. The outer bran layer of the wheat kernel (the endosperm) is incredibly rich in nutrients and when you use freshly stoneground flour, nothing has been oxidised yet, so it is as nutritious as it could possibly be. The germ contains lots of fibre, protein, vitamins and minerals, which are vital for a healthy body and immune system. It is especially high in vitamin E, which is important for maintaining a healthy immune system, as well as healthy skin and eyes.

The other key component to stoneground flour is that the body assimilates it more slowly than roller-milled flour. There is more fibre, which slows down the blood sugar response.

If you want to avoid all enzyme flour improvers or fortification then stoneground is a good choice. In the UK for example, we fortify roller-milled flour (The Bread and Flour Regulations 2012). By statute any white wheat flour that is milled in the UK must have calcium carbonate, iron, thiamine/Vitamin B1 and Nicotinic acid added. If you are a purist and want to avoid these then the only way to do this is either by buying stoneground flour from small artisan mills, or by milling your own. Students often hear me saying that artisan bread begins with artisan ingredients.

Getting the best results from freshly milled stoneground flour

Freshly milled flour is often referred to as 'green'. It is not actually green, it just has not had time to oxidise. Natural ageing of the flour by exposure to the atmosphere means that the flour has time to oxidise, which primarily affects sulphur-containing amino acids that are constituents of the gluten. The formation of gluten involves the creation of disulphide bonds, which hold the gluten together. Mixing also results in these bonds being formed and the strengthening of the protein, which is what you need to make good bread. In short, you can make bread with fresh flour, but it is generally accepted that to in order to get optimal performance from your flour it needs to age.

I have made bread with freshly milled flour many times. It is possible to bake a beautiful loaf using freshly milled flour, and I have not noticed a huge difference in volume. I don't have a technical explanation as to why you can successfully use very freshly milled flour, but I suspect it is something to do with the oxygen levels in the flour being abundant as it is milled and the development of thiols. I also think that the higher enzymes and nutrients play a part in this. If anyone has a technical explanation then I'd love to hear more.

How to use stoneground wholegrain flour

Freshly milled flour is surprisingly delicately flavoured, but for maximum gluten development ageing it for a week or so will give you stronger gluten development. The first, second and third formulas give a guide to using these. Be aware that some stoneground flours can be trickier, initially they look like they can take more water then slacken off after 20 minutes.

White versus wholegrain

When blending flour the next choice is whether you use a more high extraction flour or more wholegrain. I've never much liked going from one extreme to the other – completely white roller-milled flour is missing some of the major component parts that make up the flavour and nutrition integral to sourdough bread. On the other hand, although 100% wholegrain flour can be utterly delicious, moreish and nutty, it can also, occasionally, be heavy, leading to overly dense bread. More often than not, therefore, I find myself blending flours to get exactly the flavour and texture I'm after. You can blend either roller-milled or stoneground white with wholegrain flour.



Why we use artisan salt

Salt is vital for optimum health and if we don't have enough the body suffers accordingly. It is also essential for reasons of taste. Salt – and here I mean artisan salt – does more than improve flavour; it intensifies it. It reduces bitterness in food and enhances the sweetness and provides balance. It aids in gluten development in bread-making and acts as a natural preservative, and, amazingly, it does all of this without adding any calories.

Salt making was, up until the industrial revolution, an artisanal craft. Much like bread-making, salt too is an artisan product that has been industrialised, so we use a hand-harvested salt in our bread.

Table salt, sodium chloride, however, is a refined product, one that is devoid of minerals and is manufactured, in many cases, without any regard for the environment. So chemically manufactured table salt has no place at the Sourdough School. To those who think that artisan salt is simply for food snobs and wealthy people who can afford it, I say think again. Not only is it the most ethical and sustainable kind of salt to bake with, it is also the most nutritious. Sea salt is full of iodine, and in the various pink, red and grey salts you can literally see the minerals. Plus almost a year's worth of sea salt to make bread weekly costs less than a pint of beer in my local pub!

AVOIDING SALT

You should never completely avoid using salt in sourdough – it has significant gluten-strengthening properties, provides the base for the flavours and helps to control the speed of fermentation. If your doctor has advised you to cut down on salt, you can reduce the amount used by half but to compensate please add miso, soy or a good rehydrated finely chopped seaweed, such as dulse. This will give you more minerals and compensate for the lack of flavour, plus the extra minerals will go some way to help strengthen the dough. (As a guide I use about 5–7 grams of dry seaweed which is then rehydrated to replace half the salt. See the [miso & sesame bread](#)).



Water

Sourdough bakers often overlook the importance of water. We can talk for hours about the nuances of the flour, but actually water is key to the success of the loaf too. How much to add, when to add it and the temperature all contribute significantly to the finished loaf. The most important thing to remember, though, is that you should NOT add all the water at once when you mix.

One of the key processes of a beautiful open crumb sourdough is developing gluten when mixing, but if you add in all the water at once you will get a soup-like consistency. You have to hold back some of the water. As a rule of thumb I mix almost all my white dough at 70% hydration (so 700g of water to 1kg of flour). The remaining water is set to one side and added gradually once the gluten has been developed. This is a technique called *bassinage*. The exception to this rule is with wholegrain, which requires more like 78–85% hydration. I apologise for being vague. This is the bit where you will need to use your judgement. It is why I recommend baking the classic loaf first, so you have a point of reference.

ADJUSTING THE INITIAL WATER

For some white flours 70% hydration will not enough, especially if you are working with a higher protein flour such as Khorasan, Durum or Canadian or, occasionally, a stoneground white. The range for these flours is somewhere between 70–80%, though can be as much as 85%. Much will depend on the amount of fibre and protein in your flour, how it has been milled and its age. The amount of water you initially use is also dependent on whether you choose to do a pure autolyse or (as we do in most formulas) an autolyse with leaven. You will need very slightly more water if you follow a pure autolyse. So, despite wanting more than anything to give you an exact amount, you have to use your judgement.

THE REMAINING WATER

Almost all the remaining water is used for the *bassinage* technique, but about 25g is used to mix the [salt](#) at the end of autolyse (it facilitates the salt distribution), and another 25g or so is used in the stretch and folding during bulk fermentation. The gluten carries on developing during bulk fermentation, and stretching and folding gives the dough structure, but you need to be gentle, so the very last of your water is used on your hands to stop the dough from sticking.

Here is an example of how you use a total of 850g water:

700g in the initial mixing to autolyse (with or without leaven)

25g water to incorporate the salt (at the end of autolyse)

100g added incrementally in 3 equal amounts during mixing (once the salt has been mixed in very well)

25g to use in the stretch and folds

The key to success is adding the water a little bit at a time, so that the flour has time to absorb it. If you get in a pickle and your flour cannot take all the water STOP. Relax. Walk away from the dough and make a cup of tea. Come back after a few minutes and assess it.

THE AMOUNT OF WATER

This is really important. I am not in your kitchen and I do not know your flour. The formulas have been developed using the ones I use. Some flours, especially those containing less protein, just need less water. If you find that there is too much water in the formula then feel free to reduce it until you find the right hydration for your flour – assess, record and then try using more next time. Alternatively, if you find your flour super absorbent or you feel comfortable adding more water then do so. Slowly. You can always add more but you can't take it out! Just remember, the key is to add the water a little at a time between mixing.

WATER TEMPERATURE

The temperature of the water is a control. It acts like both the brake and the accelerator in a car. You can use warmer water to get to the desired dough temperature or you can use colder water. When hand mixing I use water at about 30°C to allow for the fact that the temperature will drop as I mix. When machine mixing I use water at about 20°C as the friction of the machine will increase the temperature of the dough as it mixes. In summer you can lower the temperature even further. Conversely, in winter, if your flour is cold you may have to increase the water temperature to compensate.

TIPS FOR ADDING IN THE WATER IN THE AMBIENT VS RETARDED

In the retarded method the mixing in of the water is vigorous. In the ambient method it is far gentler. I recommend dimpling in your fingers and adding the last of the water with the salt very gently and slowly so as not to completely de-gas the dough.

THE MYTH

I also want to dispel a myth. You do not have to filter your water or let it stand for hours. In highly chlorinated areas you can leave your water on the side for 20 minutes before you use it. Do not use cool boiled water or mineral water. They are de-oxygenated so are not great for microbial activity.



Dried sourdough: using up leftover starter

There are several reasons for drying sourdough to a powder, not least the fact that it is a great way to use up excess when refreshing your starter – no one wants to discard any. Dehydrated sourdough makes a superb flavour addition to the outside of a loaf and I often use it to dust bannetons. When combined 50/50 with rice flour it is especially useful for adding extra texture and flavour to the outside crust. You can also get creative with the flavours and use them to enhance so many everyday dishes, from cakes and pastries to mashed potatoes and muffins. I find it tempers sweetness and the added acidity can balance flavours.

Some of the best flavoured powders are made simply by sprinkling a tablespoon of a spice or herb into starter that is being discarded before smearing it thinly onto either a silicon mat or greaseproof paper. Then dehydrate for 3–7 days (somewhere warm and dry, such as an airing cupboard or a sunny windowsill). Remove the now dry flakes from the paper and store until needed. You simply grind the flakes into powder using either a pestle and mortar or a flour mill and use as needed. These keep fresh for about 6 weeks in a sealed jar once dry.

BLACKCURRANT AND FENNEL

I like to use the white French [starter](#) for this, as, after 2 days, it has a slightly citric flavour. Smear the starter over the greaseproof paper and scatter with fresh blackcurrants and a tablespoon of fennel seeds. Leave to dehydrate somewhere dry, such as an airing cupboard, for about a week. This works really well in a morning smoothie – a tablespoon per glass adds tang as well as supporting the gut microbiome as a probiotic.

CHARCOAL

Charcoal adds drama, but also tempers the acidity of the ferment, producing one of the sweetest ferments. I believe this is down to the fact that it is alkaline, and so reduces the acidity. To make a charcoal ferment, simply replace 20–30g flour in your starter with food-grade charcoal powder. Or you can make a ferment especially for powder with a tablespoon of starter, 20g charcoal powder, 40g white flour and 60g water. Ferment for a week in the fridge then smear this over some greaseproof paper and leave to dry (this one usually takes just 2–3 days). I love this as a dusting powder to enhance the colour of the darker breads such as the [Russian Rye Bread](#).

BEETROOT AND BLACK PEPPER

Ferment 60g cooked beetroot purée with 40g white flour and 20g rye at room temperature for 48 hours to get a really sour tang. Spread over greaseproof paper and add a good ½ teaspoon of cracked black pepper. This is delicious added to a dukkah spice mix.

MINT

This is one of my favourites. Blend a small handful of fresh mint into 100g cold tap water. Mix this water with a tablespoon of starter and 120g white flour and ferment at room temperature for 8 hours before popping in the fridge for 24 hours. Spread over some greaseproof paper and leave to dry (usually 2–3 days). The cold water and cold fermentation encourage the acetic acids to develop and you get a vinegary minty tang from this powder. A tablespoon is great mixed into breadcrumbs to make lamb burgers.

PARMESAN, GARLIC AND ROSEMARY

This one is easy. I simply use the discard from a wholegrain starter and scatter over about 2 tablespoons of grated Parmesan, then some freshly chopped rosemary and 3 very finely chopped garlic cloves. It is best dried somewhere warm, such as an airing cupboard. I love this as a dusting on cheesy muffins, just before they go in the oven, or on top of fish pie.

PUMPKIN AND CINNAMON

Ferment 60g cooked pumpkin purée with 60g white flour at room temperature for 48 hours to get a really sour tang. Spread over greaseproof paper and add a good ½ teaspoon of ground cinnamon. This is really wonderful as a dusting on pumpkin pie mixed with a little icing sugar. It is also great mixed with a small amount of caster sugar and sprinkled on top of a cappuccino, providing a gorgeous sweet–sour spicy tang.

CHOCOLATE

I usually use my [chocolate starter](#) to make this. I find that after a week it takes on almost balsamic vinegar sweetness. If you don't have a chocolate starter in the fridge, you can easily make chocolate ferment by mixing 20g raw cacao powder with 40g white flour and adding a tablespoon of starter, with 60–70g of 37°C water. Leave somewhere warm for 24 hours. Once fermented, spread over some greaseproof paper and scatter with a tablespoon of cacao nibs. Leave to dehydrate somewhere warm/dry, such as an airing cupboard, for 4–5 days. This is excellent for dusting chocolate truffles with.

PAPRIKA

Smear about 120g leftover sourdough over some greaseproof paper and dust with a generous tablespoon of paprika – this is absolutely delicious used in omelettes and as a finish to garlicky pan-fried cheesy potatoes.



SOURDOUGH POWDERS ARE AN INTERESTING WAY TO MAKE USE OF THE COMPLEX, SWEET AND SOUR FLAVOURS CREATED BY YOUR STARTER IN OTHER EVERYDAY FORMULAS.

Sprouting

To understand sprouting, it helps to visualise what is happening inside a seed. Once you start the germinating process by providing warmth and moisture, the dormant seed starts to become a live plant. It changes both inside and out, so, when you eat that seed, you're no longer eating just a seed, you're eating a tiny plant.

Soaking helps lower the fat content, which also helps convert the dense protein in the seed to simpler amino acids that are easier to digest. The enzymes are activated and kick in to break down the complex carbohydrates into simpler glucose molecules.

Why sprout grains?

Sprouted grains are plump and have an irresistible texture, sort of knobbly, and a sweet flavour. They add a moistness to bread that cannot be replicated by any other ingredient.

Sprouting grains also significantly increases their nutritional and bioactive content – especially the vitamin B content, particularly of B2, B5, and B6 – as well as improving palatability. In addition, germinated grains contain substantial amounts of total [phenolics](#), and rye has significantly higher content compared to non-germinated grains. These phenolics help reduce the risk of diabetic agents and cancers, including colon cancer.

If you have a particularly sensitive digestion I recommend you sprout all your seeds, including sprouting and drying the ones you use to roll on the outside of your bread.

HOW TO SPROUT

You can sprout any grain and there are several ways to use them, including:

- **directly in the bread** – I add **between 15 and 25% of the weight of the flour**. Using more is fine, but the dough can get heavy. Either put in a blender and turn into a mash or use whole.
- **to make [malt](#) powder.**

1 First rinse the grains and then soak them overnight in a bowl of cold water using double the weight of water to grains. The grains will roughly double in size.

2 After soaking, drain and rinse well, but don't touch the grains as this can transfer unwelcome bacteria on to them – use a clean spoon instead. Put in a clear glass jar, cover with a piece of cheesecloth or muslin and secure with string or an elastic band. Leave to stand at room temperature for 48–72 hours, away from direct sunlight. The grains need oxygen, so if they look too packed together lift them using a clean fork to aerate. Rinse them once a day with fresh water.

3 When your shoots are slightly smaller than the grains the sprouts are ready to use either directly into your bread or to make [malt](#). Occasionally you will need to rinse and drain them before drying, as they will have developed a cheesy smell if they have been too closely packed together. Once dried you can refrigerate them for a few days, but I find it is best to use them straight away.

Sprouting seeds

For many of the same reasons that we sprout grains, we also sprout seeds. Nuts also benefit from overnight soaking before use. These are some of my favourite seeds to sprout.

AMARANTH Although often referred to as a grain, this is the seed from a flowering plant. It is gluten free and contains three times the average calcium of other grains. The bioactive peptides in amaranth (called lunasin) have been shown to have cancer-preventative benefits and antihypertensive properties.

FLAX High in omega-3 fatty acids these seeds are also a good source of protein and fibre.

SESAME Quite possibly my favourite seed. They are a great source of iron, vitamin B1, zinc, selenium and dietary fibre. In addition to these important nutrients, sesame seeds also contain two unique substances: sesamin and sesamol. Both of these belong to a group of special beneficial fibres called lignans, which have been shown to have a cholesterol-lowering effect.

PUMPKIN These are packed full of nutrients, providing substantial quantities of healthy fats, magnesium and zinc. Pumpkin seeds contain antioxidants such as carotenoids and vitamin E, which can reduce inflammation and protect your cells from harmful free radicals and many different diseases.





Malt

At the School, we add a tiny amount of malt powder when using white roller-milled flour as the main flour in the loaf (10g per kilogram of flour), but it is worth checking your flour as some already contain malt. The malt contributes to the goldenness of the crust, and the food available to the microbes boosts your sourdough, giving a good rise and golden colour.

Malting grain is the slow, gentle process of sprouting, drying (or roasting), then milling grain. Apart from the colour and flavour this process adds, malting is used by brewers, whisky distillers and bakers to harness the ability of naturally occurring enzymes to convert starches into simple sugars. There are two types of malt, based on the presence or lack of enzymes they contain:

DIASTATIC MALT has enzymes that are still active. The enzyme's job is to convert starch into sugar, so by adding diastatic malt to dough you are further increasing the sugars made available to the microbes.

NON-DIASTATIC MALT, which has been heated to a higher temperature to bring out flavours, stops the enzymatic reaction.

You don't have to make your own malt. You can buy it easily from a good supplier of baking ingredients and equipment – or find a local brewer. They will have dozens of different flavours, including malted oats and chocolate malt. We generally use local barley to make the malt we use at the School.

A step-by-step guide to homemade malt

Malt deteriorates over time, so I tend to make it three or four times a year to keep it fresh. Store in a clean, airtight jar for up to six months. You can make malt from various grains, including wheat, spelt, rye and barley. The process takes 6–7 days.

1 First [sprout](#) 200g of grains (you tend to get just a bit less than the amount you started with, so 200g of grain gives you about 175g of malt).

2 Next you need to dry or roast the grains.

EITHER Drying can take up to 24 hours or even longer, depending on the size of the grain. I leave mine in the oven at just below 40°C (any hotter than this and the enzymes will not survive) until they are completely dry – taste one to check; if it is hard and crunchy it is dry. Mill these to set diastatic malt.

OR Roasting the sprouted grains intensifies the flavours. As the starches and proteins brown (the Maillard reaction), various flavour and colour compounds are produced. This kills the enzymes (so it's just flavoured food). See below for temperatures and timings.

OVEN TEMP	DRY/WET	TIME	FLAVOUR
140°C/gas mark 1	Dry	1 hour	Light nutty
175°C/gas mark 4	Dry	15 minutes	Light nutty
175°C/gas mark 4	Dry	30 minutes	Toasty nutty
175°C/gas mark 4	Wet	1 hour	Light, sweet, toasty
175°C/gas mark 4	Wet	1½ hours	Toasted malty, slightly sweet
175°C/gas mark 4	Wet	2 hours	Strong roast

3 Mill or grind the grains into a flour using a mill or pestle and mortar.

4 Transfer to an airtight jar and store in the fridge. Malt is better slightly aged, and the more you roast the grains the longer you need to age them – sometimes I leave the very dark ones for up to two months before using.

Smoking

Adding a layer of smokiness to your bread can create a whole new dimension and it is one of my favourite ways to play with flavour. It's like a painter being given an entire new palette. Think spelt smoked with applewood, beechwood-smoked rolled oats or smoked kibbled rye combined with dried [wild cherries](#). A word of caution though: a light touch is far more suggestive and delicious, so aim for subtlety.

You can include a smoky note in a number of ways and to different degrees: by smoking grains and then milling them into flour; by smoking grains after they have been sprouted (be sure not to get them hot – they will need to be cold-smoked) and then using them directly in the dough; or smoking the whole loaf once it has been baked.

Generally, most woods are fine to smoke with (see [list](#)), but some are poisonous (yew and laburnum) and some will have been treated with chemicals that are poisonous. Others just taste revolting. Never use wood from conifers such as pine, fir, cyprus, spruce, redwood or cedar – they contain too much sap and also taste horrible. Freshly cut 'green' woods will also have more sap and can produce bitter notes. Never use wood that has been painted. Most of the wood I use for cold smoking comes from the gardens at the School and the best time for collecting it is winter or very early spring, before the sap rises. I prefer air-dried wood chippings, as the wood is slightly wetter than kiln-dried – the water provides steam that makes the droplets larger and stickier and you get a better, rounder smoky flavour. Or you can simply buy ready-prepared, food-grade wood chippings.

The subject of smoking food is so vast that it merits a book in its own right, but there are basically two techniques for sourdough: the first involves smoking the ingredients, the second the finished loaf. Smoking the ingredients results in a subtler flavour throughout the loaf, whereas smoking the entire loaf results in a more intense smokiness, with the aroma predominantly concentrated in the crust.

I hot-smoke in a cast-iron Dutch oven using an upturned foil takeaway container, as in the photograph here, though if you prefer you can buy a purpose-made one. I place the wood chips in the bottom of the pot, then cover them with the foil container, having first punched a few holes in the top with a sharp pencil. I then place the grains or loaf on top, pop the lid on, and put over a high flame on the hob for 2–3 minutes until I see smoke seeping out from the sides. I then turn it off and leave it until it is cold.



AN OLD POT WITH A LID AND AN UPSIDE DOWN FOIL TAKEAWAY TIN MAKE EXCELLENT HOMEMADE SMOKERS



YOU CAN USE AN OLD CAST IRON POT AS A HOMEMADE SMOKER

Woodsmoke flavours

APPLE Mild with a fruity flavour, slightly sweet

ASH Light but distinctive flavour

BIRCH Not dissimilar to maple

CHERRY Mild aromatic and fruity. Wonderful flavour

CRAB APPLE Similar to applewood

GRAPEVINES Very smoky rich and fruity

MAPLE Smoky, mellow and slightly sweet

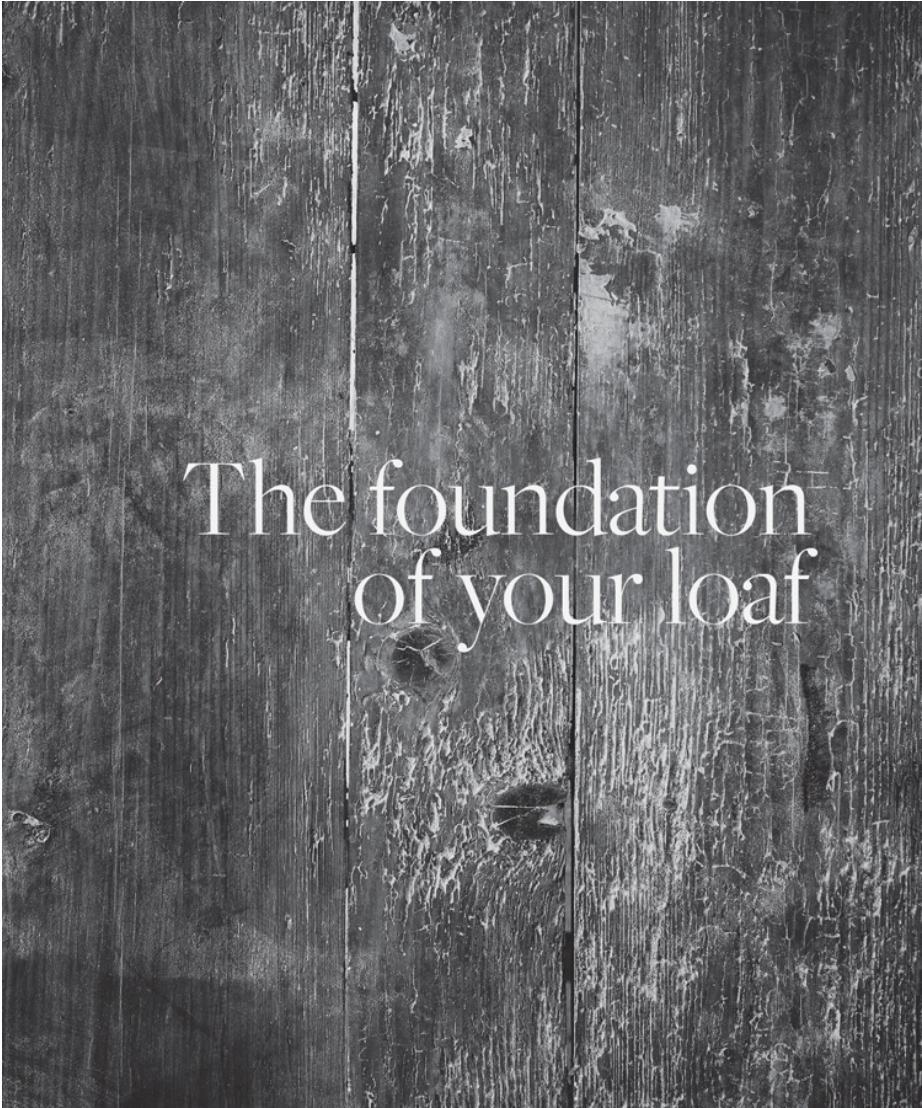
OAK My favourite. Very classic and very French

PECAN Sweet and mild with a flavour similar to hickory

SWEET FRUITWOODS (APRICOT, PLUM, MULBERRY) Mild and sweet

WALNUT Very heavy smoke flavour, usually too strong for my liking





The foundation
of your loaf



The basics: the starter

Before you begin, you need a starter, and to understand how to create and look after it. You can make your own by capturing the wild yeasts and bacteria already present on the grains that your flour is milled from. This is fun, and will give you a huge sense of satisfaction, but it takes a little time. Depending on the ambient temperature of your room and the microbial activity of the flour you are using it can take from three days to two weeks, so if you are full of enthusiasm about starting baking, I suggest that you begin by making a loaf with a thriving starter that is already producing great loaves for someone else. If you don't have a baking friend who will give you a small amount of their starter you can buy an established one from one of the online [resources](#). Scientific studies indicate that an established starter is stable, active and resilient, and in your first attempts at making sourdough bread it will guarantee a better loaf, which is more likely to keep you baking.

WHAT IS A STARTER?

Sourdough is a symbiotic microbial ecosystem made up of wild yeasts and lactic acid bacteria that have colonised the mixture of flour and water. The behaviour and the characteristics of your starter depend on the type of yeast and lactic acid bacteria, which in turn depend on the temperature at which your starter is refreshed at, the kind of flour used to maintain it and the resident bacteria in the environment that it is kept in.

DO I NEED TO UNDERSTAND THE MICROBES TO MAKE GREAT SOURDOUGH?

No – people made bread for thousands of years before we even invented microscopes or knew of their existence – though a basic knowledge will help you better understand how to change the flavour of your bread. At the School, we have students from all over the world who want to understand how they can use fermentation to experiment with flavour and make more nutritious bread. Controlling the levels of acid in the dough influences the flavour and the level of sourness, which in turn affects the gluten structure, texture and crumb of the bread. So it is very useful to understand where the acids come from and what they do.

WHERE DO THE BACTERIA COME FROM?

The flour that you use to refresh your starter is a major influence on the kind of bacteria that colonise your starter.

WHAT OTHER FACTORS AFFECT THE STARTER?

The soil that your flour is grown in can affect the kind of microbes you get colonising your starter, as can the environment in which you keep your starter and the temperature at which you refresh it. The farming practices used to grow the grain (usually wheat) also affect the [microbial composition](#)

WHAT IS IN THE STARTER?

There are two kinds of microorganisms that cause sourdough to ferment: yeasts and lactic acid bacteria (LAB). These have a mutually beneficial symbiotic relationship sharing the available nutrients from the flour. Mostly, rather than compete for food, they cooperatively protect their ecosystem from other uninvited bacteria.

There are about 23 known species of yeast, but the most common ones are *Saccharomyces cerevisiae* and *Kazachstania*. The yeasts are tiny, oval shaped one-celled fungi, though are much bigger than the LAB. When they have access to oxygen, aerobic fermentation produces carbon dioxide gas which makes your bread rise.

Sourdough bacteria are predominantly *Lactobacilli* and are also found in other fermented foods, such as kefir and sauerkraut. These bacteria are responsible for producing the unique by-products that enhance the flavours and textures of sourdough, in particular producing the organic acids that change pH of the dough. Sourdough bacteria are also found in other fermented foods, such as kefir and sauerkraut.

HOW DOES SOURDOUGH FERMENT?

When the yeasts have access to oxygen, aerobic fermentation causes them to grow more cells. Once the oxygen is then used up they change to anaerobic fermentation, which is much like fermenting beer, the yeasts make both alcohol and carbon dioxide gas (CO_2) using up the simple sugars that the enzymes have broken down. The bubbles that you see in the bread dough are the released gas and are what make your bread rise.

At that same time the LAB which are responsible for producing the unique flavours and textures of sourdough produce organic acids that change the pH of the dough, which is key to the increased nutritional value and digestibility of sourdough (see [The madness of modern bread](#)).





ARE THERE DIFFERENT KINDS OF LACTIC ACID BACTERIA?

Yes. There are many species that produce different flavours and textures, but LAB are categorised based on their by-products. The following terms might sound technical, but once you know that homofermentative LAB is the bacteria found in yogurt it becomes more understandable.

SOUR, VINEGARY FLAVOURS

Obligate Heterofermentative – Ferments glucose and produces ethanol and both acetic acid and lactic acid as well as carbon dioxide (CO₂) as by-products, which produces a more sour and vinegar-flavoured bread.

Facultative Heterofermentative – Produces mainly lactic acid but, in some cases, it can also produce acetic and lactic acids.

MILKIER FLAVOURS

Obligate Homofermentative – Ferments glucose and only produces lactic acid as the primary by-product, which is milky and produces a sweeter, more yogurt-flavoured sourdough.

HOW DO THE BACTERIA AFFECT THE BREAD?

The bacteria produce organic acids that acidify the dough. This acidity is one of the main reasons sourdough is more nutritious and more digestible. Their other job is to produce exopolysaccharides, a kind sugar slime that the bacteria like to live in. These exopolysaccharides have two main benefits. Firstly, they provide a structure and change to the mouthfeel of the bread – there are some specific bacteria, leuconostoc for example, which have been identified for producing dextran, resulting in the voluptuous, soft, sweet mouthfeel of classic panettone. Secondly, exopolysaccharides make great food for our gut microbes, even when baked.

WHAT IS A TYPICAL SOURDOUGH RATIO?

In January 2017 the School's French white sourdough starter, derived from the original French starter from the bakery I grew up baking in, was analysed by the Puratos Sourdough Library in Belgium. This analysis revealed that it contained one dominant yeast and several kinds of LAB, which is typical of the make-up of all starters.

We have four starters at the school, each one producing sourdough with different flavour profiles:

White – Sweet yogurt-like flavours

Yeast = *Saccharomyces Cerevisiae*

Lactobacillus kimchii

Lactobacillus sanfranciscensis

Lactobacillus acidifarinae

Chocolate – Lactic, both tangy milky and fruity

Lactobacillus plantarum (43%)

Lactobacillus sanfranciscensis (38%)

L. fermentum (16%)

Fructoe pseudoficulneus (12%)

Acetobacter pasteurianus (8%)

Rye – Sour and deeper, darker treacle and complex flavours

Lactobacillus sanfranciscensis (32%)

Lb. acidophilus (22%)

Lb. pentosus (17%)

Lb. pontis (8%)

Wholegrain – Sour and sweet malt and beer flavours

Lactobacillus acidifarinae (48%)

Lactobacillus kimchii (37%)

Lactobacillus sanfranciscensis (21%)

Lb. pentosus (13%)

Lactobacilli brevis (10%)

How to make a starter

To create your own sourdough starter I recommend using just two ingredients – organic stoneground flour and water. It is important that the flour is stoneground as some modern roller-milling heats the flour to temperatures that can reduce the naturally occurring wild yeast.

Choose a warm room – not hot, not cold, just somewhere that is pleasant to be in. As the starter is acidic, and will react with certain metals, it needs to be made in a non-reactive container. I prefer glass, but plastic is fine too. You'll also need a whisk, to incorporate air, and a breathable cover, such as a clean tea towel, coffee filter paper or a loose-fitting, disposable shower cap.

Begin by putting 150g organic stoneground wholegrain flour and 150g water heated to a temperature of 28°C in a large jar. Whisk the mixture vigorously and cover. Leave to sit in a warm place for 12–24 hours, but make sure there are no other cultured foods nearby or there will be a crossover and you may not get the microbes you need. After this time, you might be lucky enough to see some bubbles, indicating that organisms are present, but if not, don't worry. Discard half the mixture and replace it with 75g flour and 75g water heated to 28°C. Stir vigorously, cover, and wait a further 12–24 hours.

From now on, you will need to remove and discard half the starter before every feeding so that the organisms in the starter can multiply without the jar overflowing. If you are somewhere warm you will find activity begins quickly, usually after 3–4 days, but if you are in a more temperate climate then it can take 10–14 days for the starter to become beautifully bubbly and have enough yeasts and bacteria to bake with. When you are developing the starter keep it in a warm place to ferment. Once the fermentation is established, transfer the starter to the fridge.

You can start [refreshing](#) your starter according to the kind of bread you want.

WHAT BACTERIA CAN I EXPECT IN MY STARTER USING THIS METHOD?

You can expect to find a range of bacteria, but it's impossible to really tell without a laboratory analysis, though the bacteria will, of course, be different. Because the temperature at which the starter is kept is below 34°C, heterofermentative [LAB](#) will come to the forefront.

WHAT IF I WANT TO CHANGE MY STARTER TO A HOMOFERMENTATIVE LAB-DOMINANT STARTER?

If you want to change the make-up of your starter, take 25g of your original and swap to the appropriate refreshment method. Generally this takes about 3–5 refreshments.

WHAT IF I WANT TO CHANGE BACK AGAIN?

This can be done, though I don't recommend frequently changing starter microbes. Starters seem most robust and reliable when refreshed consistently. In my experience, it takes longer to bring a sweeter, homofermentative starter back to being a predominantly sour heterofermentative than doing it the other way round. Perhaps 4–7 refreshments. Use cooler water for refreshing and always use wholegrain or rye flour.

WHAT IF I WANT TO CHANGE MY STARTER PROFILE?

It is not as simple as changing the microbes. They will remain the same unless you change your refreshment schedule, flour or environment. However, by changing the water temperature you can encourage certain bacteria to come forward as a higher ration, which then affects the acids and therefore the flavour, for how to [refresh](#) your starter to achieve this.



CAPTURING AND NURTURING THE MICROBES

WHAT IF IT STARTS TO SMELL OR LOOK HORRID?

Your starter should not smell unpleasant. Nor should it have black bits in it or any mould. On rare occasions you may create a new starter only to find that it smells horrid or that the bread and other baked goods it produces aren't very pleasant. If that's the case, it means that the bacteria that have populated your starter are not the right kind, and the lactic acid production, which makes the starter inhospitable to other organisms, hasn't got going. You will need to discard this starter and begin again, moving the location of your starter to a different room.

Usually, people who are having difficulties making a starter have meddled with the process. Please just be patient. Do not use hot water, it should be just warm (about 28°C) and there is no need to add any baker's yeast. You can add something likely to have wild yeast living on it, such as organic grapes, but, to be honest, the yeasts that you want to encourage are most likely to be found where they will get a decent meal, i.e. on the outside of the grains that the flour is milled from.

HOW DO I KNOW IT IS READY TO BAKE WITH?

See [here](#).

WHAT IF I WANT TO GO ON HOLIDAY?

I often leave my starter for up to two weeks without any ill effects. Some people like to leave it with a friend or neighbour, but if that is not an option, maintaining your starter becomes about leaving the microbes in a super-fit condition and reducing the acidity. Before you go away, refresh your starter twice a day for two days and, in the final refreshment, thicken it, using about 60g water to 100g flour. Reducing the amount of water slows down the enzymes, which in turn slows down the rate of acidification. When you get back, build your starter back up again by giving it a good feed twice a day for two days. Then return to normal refreshment.

HOW LONG IS THE LONGEST YOU CAN LEAVE A STARTER FOR?

I've often joked that I run the RSPCSS – the Royal Society for Prevention of Cruelty to Sourdough Starters – not least because I have successfully revived a starter that has been neglected for over six months. It goes very smelly from the butyric and hexanoic acids – like Parmesan or old trainers – and gets a dark 'hooch' (see below) on top. Can you revive it? Yes, but it has to be built up again in the same way as starting from scratch. Is it worth reviving? Well, that depends on how attached you are to it. If the starter has a sentimental value, then perhaps it is worth doing. It will take a few days to get it going again with repeated refreshments, and sometimes it is simply easier to start again.

WHAT IF MY STARTER HAS A LAYER OF GREY WATER ON TOP OF IT?

This is called 'hooch'. It is a protective layer of water and alcohol, keeping out unwelcome micro organisms. It simply shows that your starter has been left for a while and needs refreshing. Just follow the same procedure as the post-holiday refreshment (see above) to build it back up again.

WHAT KIND OF FLOUR SHOULD I USE?

The kind of flour you use is up to you. I've kept British white, rye, spelt, wholegrain, heritage grain and chocolate (using 20% cocoa powder) starters. I recommend three things, though. Firstly, that the flour you use is organic; secondly, that it is freshly milled; and thirdly, that it is stoneground. This will give your microbes the most nutritional support and reinforce their numbers, which supports the health of the ferment.

CAN I CHANGE THE FLOUR I USE?

Yes, although I favour continuity. But I have often needed to change flour for various reasons, and, over a couple of refreshments, the starter takes to its new food.

WHY DON'T MATURE STARTERS MAKE GREAT SOURDOUGH?

When the yeasts are in aerobic conditions, they are at their most active. When yeast ferments in the absence of oxygen (anaerobic fermentation) it produces alcohol and slows down, which is why a sourdough culture that has been left to ferment for a while without being aerated or refreshed will develop a thin layer of water and alcohol (hooch) on the surface.

This alcohol provides a catalyst for additional flavour dimensions in the form of iso-alcohols, which contribute to the esterification of organic acids

with alcohols. In other words, you get esters forming, which make your starter smell lovely – of fruit, such as ripe apples, pears or pineapple. The reality, however, is that it is way too acidic. It needs refreshing (it is fantastic to use for a rye loaf!), but never more so than when the smell changes from fruit to nail polish remover (acetone) or even further down the line to old cheese (butyric acid). The truth is that while the esters in a mature starter smell delicious, they can't really be used because the starter is just too acidic at this point.

HOW MANY STARTERS DO I NEED?

One. Or perhaps two. I recommend keeping one hetro and one homofermentative as this means you can bake both a sour and sweeter milkier bread. But for beginners the wholegrain one is the easier and most versatile.

WHICH KIND OF STARTER DO YOU RECOMMEND?

That really does depend on your tastes and requirements. The most versatile starter is the wholegrain as it can be easily converted into white, rye or chocolate in just three or four refreshments over a few days.

HOW MANY STARTERS DO YOU KEEP AT THE SCHOOL?

I might give you a raised eyebrow look when you ask this. I have 5 or sometimes 6 or 7 or more ... I have guest starters, some of which have stayed, most of which I abandon.

HOW DO I MAINTAIN MY STARTER

The way in which you maintain your [starter](#) can affect the kind of bacteria that flourish in it. I'm not suggesting that you can choose individual species, but rather that my suggestions are based on knowledge and understanding of which conditions various bacteria and yeast prefer. In other words, how you can encourage the kind of microbes that will give you the kind of results you want.

WHY WOULD YOU CHOOSE TO CONTROL THE KIND OF BACTERIA IN YOUR STARTER?

Ultimately is it about controlling the flavour and acidity levels of your sourdough. Some people want to enjoy naturally leaven bread that is not sour, whilst others love a really distinct tang. If you couple controlling the foundation of your loaf along with the kind of fermentation method that suits your preferred flavoured bread then you can make the kind of loaf you really enjoy eating or, if you have issues with wheat intolerances, can digest.

HOW DO YOU CONTROL THE RATIOS OF BACTERIA THAT FLOURISH IN YOUR STARTER?

There are four suggested methods on [here](#) that explain how to do this. I cannot guarantee that these methods will give you the same microbes (there are hundreds of species), but rather this is a rough guide to how you can achieve similar results to the starters I have listed. There are many options to maintain starters, but my suggestions are based on the refreshment routines that we use at the School. The key to the kind of microbes that dominate your starters is the temperature. A temperature above 34°C encourages homofermentative bacteria to flourish. Below this, often the heterofermentative LAB bacteria come to the forefront.



The leaven

The leaven is often a point of confusion for bakers. Not all bakers use one and it is called by many different names. In the same way that the Bible calls the devil by many different names, bakers have many names for their ferments. Each one has a slightly different meaning.

Some bakers refer to the leaven as a pre-ferment; even more confusing are the borrowed terms from other types of bread baking, such as poolish or biga. Leaven or, in French, levain, is also referred to as the 'chief', 'chef', 'head', 'mother' or 'sponge'. Other bakers simply use the

word starter – which is even more misleading for home bakers. After all, your starter is a starter all the time. Even six months old and smelling of cheese it is still a starter.

SO WHAT IS LEAVEN?

Leaven is the second build of your sourdough army of microbes – flour and water mixed with a small amount of your starter culture and fermented, to create an active colony of wild yeasts and lactobacilli. It is almost an exact repeat of refreshing your starter. It is mixed with the flour and water from the formulas, as the inoculation that ferments the dough.

WHEN SHOULD I MAKE A LEAVEN?

The ambient method leaven is made 8–10 hours before you mix the dough to make the bread. Generally, it is made with strong white flour (which ferments at a slower rate than rye or wholegrain). Ideally, it is made late in the evening, just before you go to bed. The advantage of doing it then is that the leaven is ready to be used when you wake up, the bread can be put in the oven in the late afternoon, and you have a freshly baked, perfectly cooled loaf to enjoy in the evening. I don't recommend leaving the leaven much longer than 8–10 hours as it will become too acidic. It's not the end of the world, but the volume of the loaf will be compromised over a long, slow ferment.

The retarded method leaven uses wholegrain or rye flour to make the leaven, which ferments faster. As the dough for this method ferments for longer it is best to use a young leaven, one that is about 2–4 hours old. The timings for this means that you make the leaven about 8am and it is ready to use at midday. I don't recommend leaving it longer than 4 hours. The more you bake the more familiar you will become with the rhythm of the bake.

WHY IS IT IMPORTANT TO USE THE LEAVEN WHILST IT IS FRESH?

It is especially important to use a leaven whilst it is still young and fresh, because too much acidity will not only overpower the delicate flavours of the flour, but will also degrade the gluten in the dough, which means you lose volume. I tend to think of leaven as being young, fresh and sweet. The sour flavours develop as the dough ferments. Even if you want a sour flavour you still use a young starter.

DO I STILL USE A YOUNG FRESH LEAVEN IF I LIKE SOUR FLAVOURED BREAD?

You still use a young fresh leaven. You refresh your starter to develop the kind of bacteria that gives you the flavour you like, and retard the dough to give the LAB time to create acids as the dough proves. By doing it this way you are able to build a strong gluten network, as the dough is mixed in an acid-free dough that facilitates strong gluten development and so you get both a well sprung loaf and a sour tangy flavour through the long, slow cold prove.



SO WHY MAKE A LEAVEN IF A BAKERY SIMPLY USES A STARTER?

A bakery makes bread every day. Home bakers generally bake once a week, enthusiastic ones twice. If you've become slightly obsessive, maybe four times a week. As your starter ages, it acidifies, and refreshing it every 8 hours is not practical – trust me, I have tried it and it is an exhausting routine. By making a leaven you can refresh less often and still get a loaf with a great spring by building up the levels of microbes. To borrow the words of Richard Hart, 'Sourdough bakers are yeast farmers. Our job as bakers is to multiply yeast numbers.' It's a bit like getting the most workers possible to build a pyramid: the more you have, the easier it is to get the job done. The yeast's job is to create carbon dioxide; so making a leaven using a recently refreshed starter is the easiest way to ramp up the numbers of yeast. This way they are young, vigorous and enthusiastic. It is also, as importantly, a means of controlling the acidity.

HOW DO I ENSURE A VIGOROUS LEAVEN?

Always refresh your starter the day before you make your leaven (see [refreshment](#) guidelines). This will ensure you achieve a really vigorous

leaven, as you will be building your leaven with a starter that is biologically at its microbial peak.

HOW DO I KNOW IF MY LEAVEN IS RIPE AND READY TO GO?

The most common test – providing your starter is made using predominantly white flour – is to see if a small teaspoon dropped in a glass of lukewarm water will float. However, this alone does not indicate it is at perfect ripeness. The second thing to do is to smell and taste it. Please don't pull a 'not likely' face – baking is something that involves all your senses and you need to be intimate with your culture. You only need about ¼ teaspoon. It should smell lactic, wheaten, yogurty and still a little bit floury, and taste lightly yeasty and sweet. You should then get a slight tang, which will be almost undetectable.

The leaven will also float when it is too acidic and has gone too far, which is why you should do the taste test. You'll be able to taste the acidity, which has a citric quality similar to that of lemons, light and very tart. If you are fermenting your dough for long periods in the fridge the bacteria have a chance to produce even more acid, resulting in a flatter, sourer loaf.

CAN I CONTROL THE TIMINGS OF WHEN A LEAVEN IS USED?

You can slow the speed at which the leaven matures by reducing the amount of water to 60g per 100g of flour (60% hydration), which keeps it sweeter for longer, in effect buying you a further 2 hours or so in which to use it. This is useful if you are working shifts, are a professional baker with several batches to mix, or if you just want a lie in. You can also drop the water temperature to 18–20°C. It is best to use one method at a time, however, and to get used to the fermentation rates for that one, rather than chopping and changing. The rate of fermentation is also subject to ambient temperature changes. It is difficult to be precise about these, but as a rule of thumb the warmer the ambient temperature, the faster the leaven will ferment.

You can increase the speed at which the leaven matures by using wholegrain or rye flour to make it, and by increasing the water temperature to 30°C and maintaining this temperature during fermentation. This will mean your leaven will be ready in 1–2 hours. I would not advise rushing it any more than this.

Which method?

Just as there's more than one route to Rome, there is more than one way to get a beautiful slow-fermented sourdough loaf. In this book, I use two main methods – ambient and retarded. Each method produces loaves that taste slightly different from one another, and also, perhaps more importantly, that have different levels of digestibility (see [here](#) for more on this). You need to choose which method in order to decide which leaven to make.

Choose ambient for a sweet loaf

Sometimes known as the 'straight dough method', this is based on the way I was first taught to make bread in southwest France, in a village bakery built in 1750. It is the method I most often recommend to beginners, because it keeps you in touch with your dough. There were no fridges in the 18th century! Ambient method dough is mixed early in the morning, about 8am, using leaven that had been left to ferment overnight. It has a relatively quick rise in a warm environment and you bake your bread between 4–6pm, so it is ready for your supper. It then makes wonderful toast the next day. This method produces a less sour-flavoured loaf.

Choose retarded for a sour & digestible loaf with higher nutrition

This method involves getting your dough fermenting and then leaving it overnight to prove in the fridge, which slows down the yeast and allows the heterofermentative bacteria (which prefer lower temperatures) to get to work and produce acetic acid, giving the bread amazing sour, lightly vinegary flavours. It is the sourness that contributes to its digestibility. This method allows for more flexible timings. It is rather lovely to wake up on a Sunday morning, take your dough out of the fridge, preheat the oven while you have coffee and then put your bread into the oven. Alternatively, you can leave the dough in the fridge and bake it later in afternoon. For those who have wheat sensitivity or digestive issues it is also the method that allows for higher levels of acidity and therefore is more digestible as it can be extended to 48 hours without compromising the oven spring too much.



Schedule

The forums and social media are littered with complaints about sourdough formulas not working. Whereas most formulas are open to interpretation, those for sourdough are not. Sourdough is unforgiving, with variables between ambient temperature and enzyme activity of flour being two key reasons why so many bakers fail.

Being a good baker involves judging the flour, feeling the dough and sensing it. This comes with experience, so whilst I have given a schedule and guide to timings I cannot emphasise enough that these are flexible. To get the most out of this book you will need to bake each formula a few times to find the ideal timings for your flour and ambient temperature. Although the differences may only be subtle, they will be key to getting the kind of bread you want. Keeping a record of timings is how you to get to understand what works for you. You can also compare methods side by side to see which one gives you the best result.

The following schedule is the one we use in the bakery classroom at the School, which usually has a temperature of 22–24°C during the day and 18–20°C at night. The blank schedules are for you to record your own timings. Even if you are a seasoned baker this is a useful exercise because the layers of complexity in the schedule are ever changing. It is not just the weather, but the flour too that changes between seasons, and each year there is a new batch of flour, which will need then need re-evaluating.

Schedule

STEP	AMBIENT	RETARDED
1. REFRESH STARTER For a white roller-milled flour starter or chocolate starter	Day 1: 11am But if you are going to work then 8am would be ok	Day 1: 11pm Leave out on the side overnight
OR for a wholegrain or rye starter	Day 1: 5pm	Day 1: 6pm Leave out on the side until 10pm then refrigerate overnight
2. MAKE LEAVEN	Day 1: 10–11pm	Day 2: Between 8–10am depending on flour
3. MIX & AUTOLYSE	Day 2: 8am	Day 2: 12pm
4. CONTINUE WITH AUTOLYSE & MIX IN LEAVEN	Day 2: 8.30am	Day 2: 12.30pm
5. ADD SALT – START BULK & STRETCH & FOLD	Day 2: 11am	Day 2: 1–1.15 pm
6. END BULK LAST STRETCH & FOLD. ADD INCLUSIONS	Day 2: 2pm	Day 2: 3–3.30pm
7. SHAPE & BENCH TIME	Day 2: 2pm	Day 2: 3.30pm
8. FLOOR TIME (THIS IS ONLY USED IN RETARDED METHOD)	Day 2: 2.30pm	Day 2: 4–5pm
FINAL PROVE	This is a continuation of floor time	Day 3: Overnight in the fridge ideally at 8–9°C However if your fridge is 5°C or below, leave the dough for another hour on final prove
9. SCORE		
10. BAKE	Day 2: 4.30–6pm	Day 3: Bake anytime after 8am but ideally about 4pm

Your loaf schedule

STEP

DATE/TIME

DATE/TIME

1. REFRESH STARTER

2. MAKE LEAVEN

3. MIX & AUTOLYSE

4. CONTINUE WITH AUTOLYSE
& MIX IN LEAVEN5. ADD SALT – START BULK
& STRETCH & FOLD6. END BULK LAST STRETCH
& FOLD. ADD INCLUSIONS

7. SHAPE & BENCH TIME

8. FLOOR TIME (THIS IS ONLY
USED IN RETARDED METHOD)

FINAL PROVE

9. SCORE

10. BAKE

Keeping a record

Many of my students feel frustrated when they get good results one day and not another. However, when they ask me why their loaf hasn't turned out the way they want they cannot remember the essential details that might help me suggest where they are going wrong, details that are especially crucial if they are baking just once a week. To avoid this, I recommend keeping a record of each bake. It helps to build up a pattern, which in turn helps you to understand how your sourdough behaves. Factors such as the kind of flour you use, the ambient temperature on the day and the length of each stage all affect the final loaf. The record form here has been designed to help you capture the details of your baking. As your notes accumulate, they will give you the information needed to identify anything not going according to plan, or to repeat your 'best loaf ever'.

FACTORS THAT CAN AFFECT YOUR BREAD

- The type of yeast that has colonised your starter
- The type of bacteria present

- Your choice of flour (percentage of wholegrains, stoneground, etc. that you use)
- The amount of starter you use – larger quantities ferment more quickly
- Wetter dough ferments faster

Sourdough loaf record

Please photocopy this form or download new ones from sourdough.co.uk

DATE

WHEN WAS YOUR STARTER LAST REFRESHED?

DID YOU MAKE A LEAVEN?

TIME THAT THE LEAVEN WAS ADDED

TOTAL WEIGHT OF LEAVEN IN GRAMS

AMBIENT TEMPERATURE OF THE ROOM
YOU ARE BAKING IN

WHICH BRAND OF FLOUR?

TYPE OF FLOUR i.e. wholegrain/rye/spelt/white?

IS THE FLOUR STONEGROUND OR ROLLER-MILLED?

WEIGHT OF FLOUR not including flour in the leaven

AMOUNT OF WATER not including water in the leaven

Scores of how happy
you are with your loaf:

CRUST COLOUR AND TEXTURE Marks out of 10

HOW WAS THE CRUMB? Marks out of 10
ie. how happy are you with the amount of holes and
texture of the interior of your bread?

FLAVOUR Marks out of 10

TEMPERATURE OF WATER

TIME THAT THE FLOUR AND WATER WERE MIXED

AUTOLYSE TIME

BULK FERMENTATION

THE NUMBER OF STRETCH & FOLDS

TIME OF SHAPING

TOTAL TIME PROVING IN THE BANNETON

LOCATION OF FINAL PROVE IN THE BANNETON

AMBIENT TEMPERATURE OF WHERE
THE DOUGH IS PROVING

OVEN TEMPERATURE

TIME BAKED

Notes



Tips before you start

People often ask me what the secret to baking amazing sourdough is. They expect advice on the choice of flour or the optimal timings, but the truth is far simpler. So many of our instincts have been stifled and disconnected in life, and nevermore so than with food. Sourdough is a connector. It connects us to the earth, to the farmers, to the millers, to each other and to ourselves. Our instincts are to cherish and create, to nurture and nourish. Baking sourdough is about using our instincts. It is about passion, rhythm and intimacy, and baking great sourdough means trusting your sense of touch, smell and taste. So to answer this question, the key occurs in the moment that you make that connection. You will know when it happens, because you will fall truly, madly and deeply in love with your bread and it will become part of you.

If you want to make your bread more digestible and nutritious there are three main factors to consider. Firstly, choose either a wholegrain or rye starter to create higher levels of acetic acid. There will still be lactic acid, but these hetero-fermentative starters produce more total acidity (titratable acid), which is a measure of the complete acid levels of the bread. Evidence suggests that the higher the level of acidity the more broken down the flour, which is the key to increased digestibility and nutrition.

Take the time to build up the microbes in your starter. Following the methods outlined in the step-by-step will create a robust microbial colony for better, more vigorous fermentation, and higher levels of organic acids, whilst maintaining crumb integrity (a nice risen loaf) as the bread ferments slowly.

Secondly, ferment for longer. The longer the bread is fermented the better, so using the retarded method is best for optimal nutrition and digestibility.

Thirdly, choose wholegrain flour and blend it to provide the widest diversity of food and nutrients for your microbes. Industrial, roller-milled white flour limits the levels of nutrition and, to a large degree, flavour too. That said, it is excellent scaffolding for a lighter, more open crumb. However, the very fact that you are making your bread is amazing; so don't get too hung up on the nutrition. Experiment and make the kind of bread you love.

Although I cannot emphasise enough that wholegrain formulas are nutritionally the best, if you have digestive issues a drastic change in fibre can be a shock to the system. Start with the classic sourdough formula, with just 20% wholegrain, and get used to it. You can increase the hydration and quantity of wholegrain a bit at a time. Of course, if you are already a sourdough baker and baking with wholegrain, you can skip straight to the higher hydration and wholegrain formulas.

A more highly hydrated dough facilitates more enzyme activity (enzymes break down the flour) and creates a more open crumb. Working with a wetter dough can be challenging at first. However, the results are spectacular and have that real 'wow' factor that no other bread can touch, so it is worth persevering. Be patient, and and work through the book logically, starting with the basic formula.

What happens if my bread doesn't turn out well?

MY BREAD IS FLAT AND HEAVY

▸ This is typical of under-fermentation. It is likely that you have not [refreshed your starter](#), or that you mistimed your [leaven](#) or used a different flour

to the one I suggested.


- If all these were correct and it is still flat and heavy check the temperature you are bulking at.
- If your desired dough temperature was correct throughout the process then give your bread another half hour bulk and observe the results.
- If you have checked all the above then you have to go back to the basics. Check your starter is lively. Look for bubbles and signs of life.
- Check how much water you have added. Sometimes reducing water can hold back the fermentation, which may well be that your flour is more absorbent than the flour I have used in my formulas. If your dough is tight and there is clearly lots of fermentation going on then your flour might need a little more water.
- Make sure that you are bulking for long enough. Most bulk timings are between 3 and 5 hours, again depending on your flour and temperatures.
- If you are getting a heavy loaf using an ambient method then double check the flour in [the leaven](#) is right, and go easy when shaping. Be firm but light when handling the dough, as heavy-handed shaping reduces the openness of the crumb.
- Finally, ensure that your oven is hot enough, and that you have baked in a cloche or a Dutch oven (see [equipment](#)). This makes a huge difference.

MY SOURDOUGH IS FLAT AND LIGHT – LIKE A FRISBEE

- This is typical of overfermentation. There is almost a ripple as the dough folds and spreads. It's very frustrating but easy to correct.
- Check the kind of flour that you are using and definitely check the timings in your [starter](#) refreshment and the timings of the leaven are correct.
- Make sure you are using a thermometer to check your temperatures. You want the dough during bulk to be 26–28°C. You need to check your timings too. Make sure that you are keeping the autolyse short if you are using the retarded method.
- Check your fridge temperature if you are retarding overnight: 5°C is correct.
- It may very well be that your flour is more active and you might want to shorten the bulk fermentation.
- Check that your base white flour is between 11–13% protein. Lower protein flours need less water.
- Double check your measurements. Too much water can also cause a loaf to be flat and unmanageable, or adding in all the water at once can have the same effect. The bassinage method ensures that the gluten develops and you don't flood your bread.
- Lastly, do make sure that you are using bread flour between 11 and 13%. Wholegrain bread flour should be 11–13% and fresh: not more than 3 months old. That your base flour is a roller-milled 11–13% bread flour. If you are using a stoneground flour it will ferment faster, so you will need to adjust your timings and shorten the bulk.







Step by step

master method

[1. Refresh your starter](#)

[2. Make your leaven](#)

[3. Mix the dough](#)

[4. Autolyse](#)

[5. Add the salt](#)

[6. Bulk fermentation](#)

[7. Shaping your loaf](#)

[8. Prove](#)

[9. Score](#)

[10. Bake](#)

How to refresh & maintain your starter to control flavour

Before you begin you need to choose either the ambient or [retarded](#) method. Once you have your starter, you are ready to get going. Before you begin you need to choose what kind of [starter](#) you want, based on what you want for your bread.

When it comes to starters it is important to understand that different flours ferment at different rates, depending on the amount of enzymes and nutrients available to the microbes. Generally the wetter starters ferment faster and are more lactic and sweeter, whilst thicker, lower hydration

starters are more sour, as the acetic acid producing microbes favour more oxygen-rich environments.

White roller-milled flour that ferments at a moderate rate over 6–8 hours gives an optimal microbial colony that is ready to make a leaven with. Rye is generally ready in about 3 hours and wholegrain in about 4 hours.

WHAT KIND OF FLOUR DO YOU RECOMMEND?

I recommend using organic flour made, if possible, from grain that has not been treated at any time with fungicides, herbicides or artificial fertilisers; none of these agrochemicals belong in a starter. In short, use organic.

HOW OFTEN SHOULD I REFRESH?

At least once a week, and always the day before you make a leaven.

1. Refresh your starter

It is imperative before you start baking that you reactivate your starter and build the microbial numbers. To do this you simply remove the mother from the fridge. She will be liquid and smell sour but not unpleasant. Don't worry if there is a hooch on top, just stir it back in, or if it is very old pour it away.

1. Put your starter into a jug of water.

2. Discard the remaining starter (or keep this for the [rye](#) formula). Don't be tempted to use more as it will acidify the new starter. Clean your pot thoroughly with hot water.

3. Pour in the milky-looking sourdough-inoculated water into the now clean pot and stir in the flour. Mix well.

4. Leave the jar, loosely covered, in a cool but not cold area, such as the kitchen worktop, overnight. This way the yeast and bacteria colonise the mixture and it will be ready to make a leaven with when it is bubbly, has doubled in volume and is full of life again. When your starter is at its microbial peak it needs to go back into the fridge, covered but not totally airtight. Please remember not to use every last bit when you bake as you need some to build a new starter back up.

5. Choose your formula from [here](#) for starter to use.



If you like a sweet loaf choose between:

White starter

milky & sweet with a light tang

Encourages homofermentative LAB

This starter produces a very light-flavoured French style milky bread and it's one I was first introduced to in the French bakery when I was growing up. We use finely milled organic white flour. The starter is kept at 100% hydration, meaning equal quantities of water to flour.

HOW TO REFRESH AND MAINTAIN

25g white [starter](#)

100g organic white flour

100g water at 36°C

Mix all the ingredients in a pot, leaving room for the starter to rise again by half. Cover with a breathable lid and leave to ferment at an ambient temperature of 20–23°C for 8–10 hours. Ideally use straight away to make a [leaven](#). If that's not possible, refrigerate and use to make a leaven within 8 hours. Refrigerate the remainder in a covered pot until next needed. Refresh at least twice a week.



White startermilky & sweet with a light tang

Chocolate starter

sweet & bitter

Encourages homofermentative LAB

This starter was made using the last chocolate bar my late friend and chocolatier Mott Green gave to me. I used the bar melted to start this culture as a way of always remembering him. It is bitter sweet. I use raw cacao to refresh it because cocoa beans, which are usually fermented with lactic acid bacteria in tropical heat under banana leaves, get hot and the bacteria creates acidity in the same way as sourdough. Tropical temperatures are usually above 34°C and studies show that there are some very interesting homofermentative LAB in raw cacao, plus, because it's not heat treated. It produces some really amazing flavours. We add 5% sugar to encourage osmotolerant yeast development. That simply means the yeasts resist osmosis (water being drawn out of them by sugar, which slows or stops fermentation) and so this starter is more robust when baking sweet sourdough.

HOW TO REFRESH AND MAINTAIN

Refresh at 100% hydration at 39°C, using fine white stoneground flour, organic raw cacao powder and organic sugar to create sweeter breads.

25g white starter

75g white flour

25g raw organic cacao powder

100g water at 36°C

10g organic raw cane sugar

Mix all the ingredients in a pot, leaving room for the starter to rise again by half. Cover with a breathable lid and leave to ferment at an ambient temperature of 20–23°C for 8–10 hours. Ideally use straight away to make a [leaven](#). If that's not possible, refrigerate and use for leaven within 8 hours. Refrigerate the remainder in a covered pot until next needed.

Refresh at least twice a week at minimum and 8–12 hours before you make a leaven.



Chocolate startersweet & bitter

If you like a sour loaf choose between:

Wholegrain starter

a sweet & sour loaf that is easier to digest

Encourages heterofermentative LAB

Our wholegrain starter started life in the iconic Tartine Bakery in San Francisco. It makes beautiful tender tangy sourdough. When a small pot arrived 5,000 miles back at the School we analysed the LAB.

Lactobacillus sanfranciscensis

Lb. acidophilus

Lb. pentosus

Lb. pontis

It was still wonderfully sweet and lactic. It had been kept on a frequent 115% hydration refreshment schedule and had been used to being refreshed four times a day. I already had my white starter, but only having one starter limited the flavours I could produce, so I decided to change this one and use it as the base for our wholegrain starter. Keeping up the four times a day refreshment schedule was impossible, and I wanted to use British flour, so I reduced the hydration to 60%, making it a stiff starter and reduced the refreshment schedule to three times a week. A year later I wanted to know what had changed. The starter had retained three out of four of the LAB and lost the lowest bacteria *Lb. pontis*. It also gained two more in the pot

Lactobacillus kimchii

Lactobacilli brevis

I am certain these came from the kimchii already established in my white starter and the milk kefir in the fridge in the School.

HOW TO REFRESH AND MAINTAIN

This starter is kept at 70% hydration – reducing the amount of water enables more oxygen for the heterofermentative bacteria, which they favour –

and refreshed with water at a temperature of 15–18°C. It has a fabulous sharp tang to it and we cultivate the heterofermentative bacteria with the lower water temperature and British wholegrain flour to get a really good sourness.

25g wholegrain starter

100g organic wholegrain flour (preferably from Britain or Northern Europe)

70g water at 28°C

Mix all the ingredients in a pot, leaving room for the starter to rise again by half. Cover with a breathable lid and leave to ferment at an ambient temperature of 20–23°C for 5–6 hours. Ideally use straight away to make a [leaven](#). If that's not possible, refrigerate and use for leaven within 8 hours. Refrigerate the remainder in a covered pot until next needed.

Refresh twice a week and 4 hours before you make a leaven.



Wholegrain starter a sweet & sour loaf that is easier to digest

Rye starter

tangy, sour & fruity with good digestibility

Encourages heterofermentative LAB

I made this rye starter with Norwegian baker Martin Fjeld from Ille Brød. It is fabulously tangy and acidic and is the one I use most often if I want to bake in a hurry – the higher levels of enzymes and sugars in rye, especially when using milled fresh flour, mean that it ferments fast. We refresh with freshly ground rye flour using a small mill.

HOW TO REFRESH AND MAINTAIN

Like the wholegrain starter, this is kept a stiff starter, which increases the amount of oxygen available so favouring the heterofermentative bacteria – and refreshed with water at 14°C.

25g rye starter

100g organic rye flour (preferably from Britain or Northern Europe)

70g water at 15°C

Mix all the ingredients in a pot, leaving room for the starter to rise again by half. Cover with a breathable lid and leave to ferment at an ambient temperature of 20–23°C for 3–4 hours. Ideally use straight away to make a leaven (see for the retarded [method](#)). If that's not possible, refrigerate and use for leaven within 8 hours. Refrigerate the remainder in a covered pot until next needed.

Refresh twice a week and 3–5 hours before you make your leaven.



Rye starter tangy, sour & fruity with good digestibility

Ready to use

HOW DO I KNOW IF MY STARTER IS RIPE AND READY TO BAKE WITH?

It will have risen by about double, be bubbly, smell lightly and pleasantly of yogurt and float in water, if a small amount is tested.

WHAT ABOUT THE LEFTOVER STARTER?

Once you have used 25g of starter, the rest is discarded. I don't throw it away though – no one likes to waste food! I keep it in a separate pot in the fridge and add to waffles, scones and pancakes, formulas for which are on our website. There is, however, one very distinctive formula that uses up the discard – the [Russian rye bread](#) – uses 700g of discarded sourdough starter. The [Sourdough](#) powders are another wonderful way to recycle fermented starter.

WHY KEEP SO MUCH STARTER IN THE FIRST PLACE?

I'm often asked this question but it comes down to experience. I have noticed that smaller amounts of starter spoil more easily. About 200–250g is an optimal amount for a home baker. I cannot offer a scientific explanation for this, just many years of observation and seeing starters brought to me in clinics at the School, show that 250g is a critical mass for ideal microbial health.



Ready to use

WHITE LEAVEN FOR AMBIENT METHOD: READY IN 6–8 HOURS



2. Make your leaven the foundation of your dough

You can use any starter to make a leaven. The thing that really matters is that it has a robust community of microbes that have been recently refreshed.

The following timings are based on the ambient temperature in the School classroom, which is 20–23°C.

Leaven using the ambient method

For the ambient method I suggest using white flour as it ferments at a slightly slower rate than wholegrain or rye and so will be ready to use in 7–9 hours. It will still be usable for a further 2 hours, enabling you to mix your leaven, get a good night's sleep and use first thing in the morning.

25g sourdough starter

100g strong white bread flour

90g water at 26°C



RYE AND WHOLEGRAIN LEAVEN FOR RETARDED METHOD: READY IN 2–4 HOURS



Leaven using the retarded method

I suggest you use either rye or wholegrain flours as they are generally faster fermenting because they contain more enzymes and nutrients. Either of these flours will make a leaven that will be ready in about 2–4 hours. It will also be usable for a further 2 hours, though this is not ideal.

25g sourdough starter

100g rye or wholegrain flour

100g water at 30°C



Mixing

Let me start by saying that all the loaves in this book were hand mixed. Perhaps my favourite part of the process is when I actually get my hands into the flour and water and feel the dough coming together. It is important to get mixing right as it is a crucial part of baking and an aspect that many home bakers overlook. At the School, I teach how to mix by hand which, for domestic bakers, is very much part of experiencing the sensory nature of baking. I encourage people to feel the dough and become familiar with the way the flour hydrates. Getting to know the feel of it as it comes together helps you to understand how the flour behaves.

The speed and length of the mixing is integral to the success of the final loaf. The mixing develops the gluten, so affects the structure of the loaf. If the mixing time or speed is misjudged, the texture and the grain of the crumb can be compromised. To get uniformity of dough, you have to put in just the right amount of energy to mix the water and the flour and develop the gluten.

I recommend mixing using a lot of energy. You will develop some good muscles over time. You can also stretch and fold the dough once the flour and water are incorporated. Using a mixer will give you a stronger gluten network, however all the breads in this book were hand mixed.

If you want to mix larger amounts of dough I recommend using a mixer with a spiral action. This is better for dough development because it gently mixes the dough without overworking it. The bowl of the mixer rotates as the spiral hook is spinning to knead the dough. This means that the spiral hook is kneading only a portion of the whole dough mass, which keeps friction-generated heat low and results in a consistent mix. This is really important, because if the temperature of the dough isn't right, it will affect the rate of fermentation, which in turn affects the volume of the bread and the colour of the crust.

A good mixer needs to be heavy and robust so it stays put while weighty dough is being tossed around. It will also have multiple speeds to give the baker more control over the dough development. Low speed helps bring the mix together into a homogenous mass. The higher speeds are used in short bursts of rest/mix for between 8–20 minutes, depending on the amount of dough and the temperature as the salt goes in to develop the gluten structure of the dough. When using a mixer you need to take into account the likelihood of friction raising the dough temperature, and adjust the water temperature accordingly.

3. Mix the dough

1. When your leaven is ready to use it will be bubbly, fresh and smell similar to live yogurt.

2. When you first mix it is essential not to add all the water in at once. You mix in just 70% of the water from the formula for white and circa 80% for whole grain.

Set the remaining water to one side as this water is going in, but not yet (see for [water](#) advice)!

3. Add the water and leaven to a warmed mixing bowl. You can add more water later, but it is important that it is the correct temperature, as this

will determine the speed of fermentation. The initial dough temperature needs to be 28°C for optimal yeast development. In winter, I use water at 33°C as the temperature drops when I first mix. In summer, I reduce the water temperature to 23–26°C depending on the warmth of the day. If you are in a hot country you will need to reduce the water temperature further still.

4. Whisk well to get rid of any lumps and incorporate air.

5. Add the flour.

6. Mix well for a couple of minutes, ensuring that all the flour is incorporated. This mixing encourages the gluten to develop. Stop mixing for step 4 to autolyse, then you will continue mixing at step 5 when the salt is added. It is really important that you rest for a few minutes between mixing to develop the gluten.



4. Autolyse

This refers to the period of rest after the initial mixing of flour and water, which allows the flour to absorb water without the inhibiting presence of salt. It gives the gluten and starches the chance to form, which leads both to better dough development and better flavour. Breads made with autolysed dough are easier to shape and have more volume and improved structure. There is a short autolyse for the retarded method, and a longer one for the ambient. A true autolyse occurs without the addition of leaven. At the School we autolyse for 20 minutes without leaven, but pre salt. Then we add the leaven, and continue the second part of the autolyse without salt. I regard the addition of the salt as the end of the autolyse. I've heard this step referred to as 'fermentolyse', but for simplicity, since most bakers around the world agree that this term has evolved from its original definition, it is referred to as autolyse.

TYPES OF AUTOLYSE

1 Pure autolyse or pre-leaven. Traditional French bakers mix just flour and water.

2 Autolyse with leaven. Most formulas call for this technique.

WHY DO WE HAVE A PRE-LEAVEN AUTOLYSE?

Pre-leaven is the stage when the mixing takes place. Mixing develops the gluten and it is best to do this without any acidity from the leaven.

WHAT TEMPERATURE DOES THE DOUGH NEED TO BE DURING AUTOLYSE?

- By hand: keep the bowl covered with a wet tea towel or wax cloth. The warm water should keep the dough at 28°C initially but it is best not to allow the temperature to drop much below 23°C.
- By machine: 20–22°C.

HOW DO I KEEP THE TEMPERATURE CONSTANT?

You need to use a thermometer to measure and you can either use a proving box such as a Brød & Taylor, or sit the mixing bowl in a large washing-up bowl and top up regularly with warm water. Alternatively, pop the bowl, covered, into the oven with just the pilot light on. What matters is that you keep dough at its optimal fermentation temperature (between 23 and 28°C). Do not be tempted to go warmer: more heat is not better!

WHY DON'T BAKERIES DO THIS?

Most bakeries are warmer environments than domestic kitchens and they ferment a lot of dough which self insulates.

SO HOW DOES IT WORK?

During the autolyse the flour absorbs the water, becoming fully hydrated. This activates enzymes in the flour that stimulate the proteins to start gluten development. At the same time, other enzymes are starting to break starch down into the simple sugars that will feed the yeast during the bulk prove. These two processes would happen during traditional dough-making, but importantly, during autolyse they are happening before any kneading is done, and the total amount of kneading is reduced. Too much kneading can result in an overoxidised dough, which detracts from the finished bread's colour, flavour and texture.

Like many aspects of bread-making, the autolyse technique is used in different ways by different bakers. The length of time allowed varies – usually between 30 minutes and 2 hours is recommended. The length of the autolyse will affect the amount of stretching and folding required once the leaven and salt are added. I generally find that bread made with stoneground flour improves with a longer autolyse. This is because the extra moisture, coupled with the stoneground milling process, means that the flour has larger starch particles, which means that it absorbs the water more slowly. Autolyse gives the flour the chance to hydrate and the proteins have the opportunity to bond before the dough is handled, which makes the most of the gluten present.

WHY DO WE TEND TO AUTOLYSE WITH LEAVEN AT THE SCHOOL?

Mainly because I have seen no visible difference between autolysing before and after adding leaven. This is because we hand mix, which makes it easier to distribute the leaven evenly when adding it in with the water in the initial mixing, and because of the long fermentation times. Occasionally, we autolyse without leaven, for example in the baguette and rye formulas.

WHAT ABOUT THE SALT?

Adding the salt marks the end of the autolyse. It is never added until this stage because it tightens the gluten network. You can feel this effect when you mix salt into the dough – it becomes harder to stretch out during kneading. You are looking to develop the extensibility of the dough during autolyse, and adding the salt before this stage is complete would work against this.



Autolyse: what, why & how

Autolyse is a deceptively simple process that can be easily introduced into your bread-making routine. It delivers a dough that's easier to work with and to shape, and a loaf with better texture, rise and flavour. Just combine the flour and water in a bowl and mix until no dry flour remains. Do not be tempted to knead. Cover the bowl and leave it in a warm place for anything from 20 minutes to up to 3 hours. During this time, gluten development begins and simple sugars start to form as starch is broken down. Although it may look like nothing is happening, you will notice the difference as soon as you handle the dough because during the autolyse it will have become smoother and more elastic.

Professor Raymond Calvel introduced the technique in his book *Le Gout du Pain* (published in English as *The Taste of Bread*). He was a research chemist who pretty much single-handedly transformed French bread-making. It's hard to imagine now but, despite its long history of excellence, after the Second World War the quality of French bread was in decline. Calvel, who trained many well-known bakers and cooks, including American chef Julia Child, focused on finding ways to improve the flavour and character of French bread. His experiments revealed that mixing flour and water, then allowing this mixture to stand before adding yeast and salt, reduced the total mixing and kneading time required. This resulted in bread that has a creamy crumb and good flavour.

5. Add salt for flavour & strength

Your autolysed dough should show bubbles and signs of life. This is also the step where you add miso, soy or seaweed if they are included in the formula.

1. Sprinkle the salt evenly over the dough and mix in.

2. Use 25g from the total water and evenly distribute across the surface to integrate the salt. Mix well, first by dimpling your fingers into the dough, then by pushing your hand in and twisting, mimicking the movement of a mixer. Do this for 2–3 minutes until the salt is fully incorporated. You will feel the gluten developing as you do this. This is now ready for the bulk fermentation.

EAU DE BASSINAGE

One of the questions people always ask is how they can open up the crumb structure of their bread. One of the ways you can do this is to incrementally add water. Once your gluten is developed you need to add in the remaining water a little at a time. This technique is known in France as 'eau de bassinage'.

The remaining water is mixed into the dough incrementally 20g at a time. Mix, then rest for a minute. If the dough looks saturated, wait a couple of minutes.

Once all but the last 45g of water has been incorporated, sprinkle the salt evenly over the dough and use about 25g of the water. Mix in and continue to mix to develop the gluten. The last saved 20g of water is best saved for the stretch and fold.

RETARDED SALT TECHNIQUE

- Mix the salt in well. When I am mixing on a machine I mix for 3 minutes, rest for 5 minutes, then repeat three times after the salt is added.
- Once the gluten is developing you will feel the dough tighten. Leave it for a couple of minutes to relax.
- Then start adding in the rest of the water using a bassinage.
- The dough is now ready for bulk technique

AMBIENT SALT TECHNIQUE

- This is a gentler technique. We aim to mix the salt in but without losing too much volume.
- The bassinage water is added incrementally and the last 20–30g is worked in during the bulk stretch and fold.



6. Bulk fermentation stretch and fold

1. You now leave your dough to ferment, during which time you will need to stretch and fold it, which helps to give your bread structure.

2. How to stretch and fold

Instead of traditional kneading, we teach a stretch and fold technique. This helps the gluten in the dough to develop. During the bulk fermentation, you need to stretch and fold the dough in the bowl three times at evenly spaced intervals (= 3 x 4 stretches). To do a fold, dip one hand in water to prevent sticking (or use a really light olive oil). Shake off the excess water. Grab the underside of the dough, stretch it out, and fold it back over itself. Rotate the bowl a quarter turn and stretch and fold more of the dough. Do this rotate, stretch and fold two or three more times, then stop. It is important to be progressively gentle each time, so as not to lose volume.

Inclusions Add fruit, nuts, seeds inclusions on the last but one set of stretch and folds.

Porridge Add porridge on the second set of stretch and folds. It is often not completely incorporated, leaving something of a thin marble-like effect, but this is fine.

3. At the end of the bulk fermentation the dough should feel firm and aerated. There should be a 50% increase in volume for the retarded and 60% increase for ambient. If you cut it open you should be able to see bubbles. If not, continue fermentation for a further 30 minutes to an hour or so.



PRESHAPE – BOTH AMBIENT AND RETARDED



If you are baking ambient method, you need only preshape

7. Shaping your loaf

create the scaffolding

There is one main distinction when shaping the dough between the ambient method and the retarded method. For ambient it only needs a light preshape. For retarded it must have more strength for the longer prove time, so the dough needs a second shape to tension it.

1. If you are new to handling dough, a drop of oil on your hands will help create a natural barrier. Lightly flour both your dough and the work surface. (If you have digestive sensitivities use rice or potato flour or [sourdough](#) powder). Turn out your dough onto the work surface. Divide into the number of loaves specified in the formula you are following. You can either do this by eye or, if you are unsure and prefer to be exact, by adding together the weight of the ingredients in the formula and dividing by the number of loaves to give you an exact weight. Using a scraper to cut through the dough, stretch out each piece very gently to the size of a small dinner plate. Apply the following steps to both pieces of dough.

2. With your scraper at an angle of 45 degrees scrape under the dough. This loosens it from the work surface making the next step easy. Place your left-hand index finger in the centre and, working your way clockwise around the dough, fold in the corners to form a tight boule (round) shape. Once you have a boule, flip it over. All the joins are on the bottom now. Be gentle but firm with your dough when you are shaping.

Being gentle but firm, work each piece into a round by using the scraper, still at 45 degrees, and your hand. The dough will stick slightly to the surface as you rotate and drag it. The aim is to create an even tightness and tension that becomes the crust. When it is nicely structured it will hold itself together. This takes time and practice. (There are also videos of this step online.)

3. BENCH REST

You must now bench rest the dough for 20 minutes or so to give the gluten time to relax. You put in the final structure on the next shape. If you are baking using the ambient method, this step is not strictly necessary.

4. Once your dough has bench rested, it's ready for its final shaping. (Following static pictures in a book is perhaps the most challenging way to try and learn to shape.)

If you are making a boule, dust a seasoned banneton well with flour or [sourdough](#) powder to stop the dough from sticking.

Any coatings, such as malt flakes or seeds, can be added at this point by scattering them on a large plate and rolling over the top of the dough (i.e. the surface that is going to be facing down in the banneton) over. You can then transfer any that are not used back into the jar.

Slip your scraper beneath the dough and lift it, being careful to maintain the shape. Place the dough seam-side up in the pre-floured banneton for the second shape retarded method. DO NOT dust the top with flour. Leave the dough for 10 minutes for the gluten to relax.

Stitching

You can further tighten the dough by pulling pieces from the outer edge into the middle. The natural behaviour of the dough is to stick to itself and so this creates more tension. This is a brilliant trick to increase the strength on the final shape and especially useful if you are new to shaping. Pulling the dough simultaneously from opposite sides of the banneton is actually the same principle as lacing a boot, creating equal tension on each side. By the end of your shaping, the dough should have a taut outer membrane that will give you a superb classic sourdough crust.

If you are making a batard

Follow the instructions for shaping a boule, but, once the boule is shaped, place both hands on the boule and roll it backwards and forwards with pressure moving the dough away from the centre to create pointed ends.

Place the boule batard with the seam side down on a floured couche (similarly to p.149). Prove until ready to bake.



SECOND SHAPE – FOR RETARDED METHOD ONLY

8. Prove

increase the volume

For the retarded method

FLOOR TIME

This step is for the retarded method only. In the ambient method there is just one final proving, but in the retarded method this is the chance for bakers to give the dough some time to continue fermenting at a higher temperature before it goes into the fridge. Depending on how fast or slow the fermentation is, and the ambient temperature of your kitchen or bakery, this can be anything from 20 minutes to an hour. It takes time to get to understand how the dough behaves, and each formula is different, but the purpose is to give the dough a final prove at ambient temperature. Once this is completed, the dough is ready for the final prove in the fridge overnight.

FINAL PROVE

Give the top of the dough a very light dusting of flour, cover with a clean tea towel and transfer to the fridge for the final prove overnight. Ideally, it should be set to a temperature of 8–9°C. Professional bakeries have provers that can be set to this temperature, but, for health and safety reasons, domestic fridges are normally set to 5°C or lower. If it's not possible for you to have a separate fridge in which to ferment your bread, and you are using a domestic one, find the warmest spot using a fridge thermometer. This is often at the top, at the front, though not if you have an ice-making compartment here. The biggest input of heat is the warm air that rushes in each time you open the door. As cold air sinks, it collects at the bottom. Frost-free fridges tend to circulate the air and have much more even temperature distribution. If your dough has not risen sufficiently, it will be because the fridge is too cold, so you might need to extend the floor time.

It is worth noting that if you want to achieve the maximum breakdown of proteins – which is important for anyone with suspected wheat sensitivity – you can leave your loaf for a further 12–24 hours. The compromise is 10–20% less oven spring, however this is of little concern for people who need maximum digestibility.

For the ambient method

There is no floor time needed for this method. Confusing, I know, but the dough is already on the side! You simply leave it to continue to prove in the ambient temperature of the room (this is the final prove for this method). In the summer when it is warm, or with higher hydration dough, you can place the dough in the coldest part of the fridge for 30 minutes to an hour to cool it down at the end of this prove. The advantage of this is that cold dough is far easier to score and generally gets a slightly better oven spring.



Prove

How to tell if your dough is ready to bake

The golden question. You have built an army of microbes, built the dough structure, shaped it and built tension and proved it. Is it ready? The strange thing is that knowing if it is ready is actually about getting to know your dough. I can't teach experience, only practice will give you the understanding of how each nuance affects the doughs readiness. That said, there are indicators that the dough is ready. It will have increased in size, generally by about 50%. The gluten is a series of elastic air pockets that have caught the air like balloons. You need there to be some tension still in the dough. A typical mistake a beginner makes is to push this point as far as possible, thinking that the more air the better. The dough actually needs to have somewhere still to expand to as it goes in the oven, or the 'elastic' gluten will be weak, acidified and over-extended and it will ripple as you turn it out and deflate. The opposite is true if you under prove. The dough will be heavy as there is no air in the gluten network, and your loaf will be dense.

You will need to stay close to your dough and get a sense of it coming alive. Look for texture and small bubbles. Look for an increase in volume. The more you do this the better you will become at judging whether it is ready. Once the bread is in the banneton you can check the last stages by touching the dough. As a general guide:

- if it springs straight back when pressed it is immature. It needs longer.
- if it answers you back in a considered way, gently and evenly, it is ready to bake.
- if it is very puffed up and you leave a fingerprint in the dough, it is bordering on over proved.
- if it completely deflates when you press it, it is over proved.

If the dough is over proved and you feel like bursting into tears, don't completely despair. You rescue it by transferring it to a tray, dimpling the

surface and throwing over 150ml olive oil, 6–8 garlic cloves, a tablespoon of coarse sea salt and a large handful of rosemary sprigs in and around the dough – it will pass as a very respectable focaccia. Note down your timings in your loaf record sheet and adjust accordingly. For over proved dough, reduce the timings, and for under proved increase them.



How to tell if your dough is ready to bake

9. Score score and bake

I've separated scoring into its own step, but really this is a split-second movement literally moments before the bread goes into the oven. Scoring your loaf is not actually essential, but understanding the effect of scoring is key to getting a more open- and better-structured loaf.

In the heat of the oven the dough expands. By scoring you give the bread the opportunity to expand freely. Making shallow cuts results in a more open crumb and a beautiful pattern in the bread and, if you get it right, you get a much-coveted 'ear'. This is more pronounced on oval or long loaves.

The success of the score depends on many factors: the tension that you build as you shape, the integrity of the gluten, which depends on the bread being perfectly proved, the sharpness of your blade, the speed and angle that you cut at, and the ear that forms is also dependent on there being enough steam around the bread as it bakes and, finally, it is dependent on the oven temperature being correct. If your oven goes to 230°C then this is the best temperature to use. I have recommended to bake at 220°C as most ovens can reach this. Keep the second loaf in the fridge while the first one bakes.

HOW TO SCORE

- Use a lame, never a kitchen knife as these are not sharp enough.

- Relax, but once you score get your dough straight into the oven. To begin with, start with a single cut, with the lame, made in one smooth movement using the blade at a 45 degree angle down the bread. Think of a surgeon at work. Not a tree surgeon – no sawing motions! I recommend you turn your bread out with the shortest end facing you. I like to score slightly to one side (I prefer the right but I am right handed,) and slightly curved, moving with the natural curve of the bread. Start at the top of the dough and bring the blade towards you. Under NO circumstances do you put your hand in the way, and pressing on the dough deflates it. It's one movement.

- Once you have mastered this you can do a Picasso if you want, personally I only rarely score a fancy pattern as each cut deflates the delicate gluten network you have built. It takes practice to get it right and even after so many years of baking I occasionally get it wrong some days.



SCORE AND GET STRAIGHT INTO THE OVEN



Score

10. Bake heat and steam

1. About 45 minutes before your bread is ready to bake, preheat your oven to 230°C/gas mark 8 (or 250°C/gas mark 9 if your oven will go that high) and place a La Cloche baking dome or Dutch oven in it to get hot.
2. If baking a boule, once your oven has reached 230°C/gas mark 7, carefully remove your cloche or Dutch oven, making sure not to burn yourself, and, if using a cloche, generously dust the base (inside) with polenta or semolina. If using a Dutch oven, tear off 40cm of baking parchment and use it to lower the dough into the pot. Once the lid is on you can trim the paper to size, but remember to leave enough length to get the bread out of the pot once it has been baked.
3. Take one of your loaves out of the fridge. Carefully remove the lid of your cloche or Dutch oven and turn the dough out onto the hot base, taking care not to burn yourself. [Score](#). If you are someone who struggles to do this, a couple of snips with very sharp scissors is a good alternative. If you don't do this the dough will split anyway, so by scoring it you decide where the bread expands and can better control its shape.
4. Once your bread is in the oven reduce the temperature to 180°C/gas mark 4, but do check each formula, as some have specific baking temperatures, depending on the inclusions. Bake for 1 hour. After this time, remove the lid and continue baking the loaf for a further 5 minutes or so until the crust is a deep golden brown – use your judgement, it can be longer if you like a darker crust.
5. Remove the loaf from the pot and transfer it to a wire rack to cool. In this moment your bread should be glorious. It will feel light and the crust will be burnished with a range of beautifully rich golden copper and mahogany colours. My sourdough rarely hangs about for long, but it is best stored wrapped in linen or cotton, and the sourness actually improves with age. Eat within 1 week.

If you only have one cloche or Dutch oven, repeat from step 1 with your second loaf (it is advisable to keep it in the fridge until you bake it, or it may over prove).

HOW LONG DO I NEED TO BAKE FOR?

I recommend that you bake your loaf for 1 hour and then remove the lid and continue baking for a further 5 minutes or so until the crust is a deep golden brown. However, what is right for one person is not right for another. It can be longer if you like a darker crust, or a few minutes shorter if you like a lighter crust.

WHY IS IT SO IMPORTANT TO USE A DUTCH OVEN, LODGE PAN OR CLOCHE?

Many people just use a baking stone to bake their bread, but using a cast-iron Dutch oven, lodge pan or a La Cloche baking dome makes the difference between a good loaf and a great one. Domestic ovens are not great for baking bread. They are temperamental and have hot spots and the heat is usually from one direction. Often the seals are not airtight and they have draughts. They also dry the crust out too fast. Putting the lid on your cloche or Dutch oven means that the steam let off by the bread as it bakes is trapped. This steam is fantastic at keeping the crust soft, which allows the dough to expand. It is also very forgiving if your oven is fierce.

WHAT HAPPENS AS YOUR LOAF COOLS?

When a baked loaf starts cooling, the starch changes from a chaotic to crystalline structure – the granules link together, which gradually changes the jelly-like crumb straight from the oven to a firmer texture that we like to eat as bread. This reaction continues until ultimately the crumb becomes cold as the water evaporates. It then begins to turn stale.

What happens in the oven?

DOUGH

TEMPERATURE	EFFECT
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20–45°C	When your sourdough is placed in the oven it quickly rises in temperature, taking the yeast to its optimum for gas production. This is the beginning of the ‘oven jump’.
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55–60°C	The ‘thermal death point’ occurs at 45–50°C. Both the lactic acid bacteria and the yeast die. Most of the oven spring has happened by this point.
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60–70°C	At 60°C the gluten network denatures and breaks apart, releasing the water it is holding. This is the end of the ‘oven jump’ because the gluten network breaks apart and the gas starts to escape. At this temperature, the starch in the dough sucks up the released water and gelatinises. Gelatinisation is the starch granule that swells by the absorption of water and explodes. This means that the starch chains inside the starch granule start leaking out.
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70–80°C	By this stage the loaf has been in the oven for almost 20 minutes and the bread shape is pretty much formed. Amylase activity decreases and the gluten is denaturised fully.
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80–90°C	The gelatinisation of starch stops at 90°C.
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90–100°C	100°C is the boiling point of water. Steam escapes, maximum internal dough temperature is reached and the crust begins to colour.
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100–175°C	This is the magic point of flavour as ketones and aldehydes (organic compounds that form flavour) and while a considerable amount evaporates during baking they contribute significantly to the irresistible smell of freshly baked bread. This is also the zone where the Maillard reaction takes place.
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175–230°C	There is continuation of the Maillard reaction and caramelisation of the crust. This is also the point at which, according to a German study, an antioxidant called Pronyl-lysine is formed by the reaction of the protein-bound amino acid L-lysine. This is a potential cancer-preventing antioxidant bread that is eight times more abundant in a dark crust than in the crumb.
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Formulas

[Classic white sourdough boules](#)

[Classic sourdough higher hydration](#)

[Classic 50:50 wholegrain/white sourdough boule](#)

[Classic: wholegrain sourdough boules](#)

[100% heritage sourdough in a tin](#)

[Russian rye bread](#)

[Seeded sourdough boules](#)

[Blackberry, poppy seed & pea flower water bread](#)

[Wild garlic boules](#)

[Jalapeno & cheese loaf](#)

[Olive and pickled lemon butter bread](#)

[Tomato & herb bread](#)

[Scandinavian buttermilk sourdough](#)

[Sweet berry bread with rosewater served with crushed fermented berries](#)

[Chocolate & roast hazelnut bread](#)

[Rosinbrød](#)

[Beetroot, black pepper & feta batards](#)

[Earl Grey, fig & kamut® loaf](#)

[Smoked kibbled rye & wild cherry sourdough](#)

[Miso & sesame](#)

[Soy, ginger & rice sourdough boules](#)

[Pumpkin & polenta sourdough](#)

[Honeyed porridge loaves](#)

[Yogurt light spelt boules](#)

[Kefir milk sourdough loaf](#)

[Malted muesli boule](#)

[Einkorn & spent ale grain sourdough](#)

[Cracked black barley & stout bread](#)

[Sourdough baguettes hybrid & 100% sourdough](#)

Classic white sourdough boules

MAKES 2 LARGE BOULES OR 3 BATARDS OR BOULES › 73% HYDRATION

LESSON ADDING WHOLEGRAIN FLOUR › LEVEL BEGINNERS

› INGREDIENTS

225g [leaven](#)

735g water for the dough

800g strong white flour

200g stoneground wholegrain flour

5g diastatic [malt](#) powder, optional

20g fine sea salt

› **SUGGESTED STARTER** Any starter as long as it is active will give you great bread, but if you want a tangy loaf use a rye or wholegrain starter. If you prefer a sweet, light-flavoured loaf use a homofermentative white or chocolate [starter](#), for instruction on starters.

› **SUGGESTED LEAVEN** Choose according to [method](#).

› **SUGGESTED METHOD** When you first bake I recommend you use the ambient [method](#). Sometimes called a ‘straight dough method’, meaning that there is no retarding, it’s a great way to learn, gives you a light flavoured loaf and you stay connected to the dough all day. However, you can use whichever method you prefer according to your taste and schedule.

› **BEFORE YOU BEGIN** Make sure you read the [Step by step](#) chapter, and use both a dough [schedule](#) to plan your timings and a [loaf record](#) sheet to assess your bread.

This is the School’s classic sourdough formula, the one we use to teach beginners, as it gives reliable results and helps build confidence. It’s made with predominantly white flour and 20% stoneground wholegrain flour, which means that although it’s perfect for learning the basics, it doesn’t reach the full nutritional or flavour potential of a sourdough loaf. It is, however, the easiest one to handle to learn the techniques I teach. I recommend you bake it at least 5–7 times to get a feel for the timings before you move on to other formulas – familiarity will give you a better understanding of the process – and that you try all three methods to see which one suits you best.

Try to use the same flour each time to begin with, as this will help you to recognise the nuances of the dough as the seasons change. What might appear to be pretty subtle differences become more noticeable as you improve as a baker. With time, you will notice that the dough feels slightly different with each batch that you bake. Once you have become familiar with this formula, move on to a formula that uses more wholegrain flour.

Advice

▸ The strong white flour we recommend is roller-milled and generally between 11 and 13% protein, which is considered a middle range of flour strength. (Flour bags that do not have stoneground written on them are generally roller-milled flour, and you can get this kind of flour from almost any good store.)

▸ Remember to reserve water from the total for when you add the salt.

▸ The addition of diastatic malt is optional. It adds colour and flavour as well as extra enzymes, which convert the starches into to sugar for the microbes to use and is useful when using refined roller milled white flour, but not stoneground white.



Classic white sourdough boules

Classic sourdough higher hydration

MAKES 2 LARGE LOAVES › 82% HYDRATION › LESSON INTRODUCING MORE WATER TO THE DOUGH

› INGREDIENTS

225g [leaven](#)

825g water for the dough

800g strong white flour

200g stoneground wholegrain flour (11.5)

10g non-diastatic malt

20g fine sea salt

› **SUGGESTED STARTER** White or wholegrain

› **SUGGESTED METHOD** Retarded

Once you have mastered the [classic sourdough boules](#), you might start to wonder how you can get larger holes – what bakers refer to as a more open crumb structure. This is achieved through minor changes to several factors in the basic formula, including mixing well in the beginning to develop the gluten and adding more water. So this is the higher hydration version of the basic loaf.

Generally, the more water you add, the more open the crumb. A common phrase you will hear bakers using is ‘the wetter, the better’. This is not strictly true, as you can over-hydrate flour and end up with a sloppy batter. To avoid this it is best to add more water just a little at a time. The French term for this is *Bassinage*. There isn’t a direct English translation, but it means water that is worked into the dough in small increments during the bulk fermentation. A traditional technique, it involves setting aside some of the water and mixing the dough slightly firm in the first place. By doing this you develop the gluten in a stiffer dough and then ‘let it down’, with the remaining water. Many domestic bakers misunderstand and add additional water, and it is a disaster. You will likely get flour soup!

So please, take note! The water is reserved from the total and added in later.

Advice

- › Depending on the ambient temperature and the flour, you may need to reduce the bulk fermentation times by 10–15 minutes, as wetter dough has more enzyme activity and therefore proves faster.

- › Higher protein flours take more water, and lower protein ones less, but it is worth bearing in mind that lower protein flour also rewards the baker with more tender crumb structure.

- If you are a beginner and struggling, you may halve the amount of bassinage water and discard it.



Classic sourdough higher hydration

Classic 50:50 wholegrain/white sourdough boule

MAKES 2 LARGE BOULES OR 3 BATARDS OR BOULES › HYDRATION 85% › LESSON ADDING WHOLEGRAIN FLOUR

› INGREDIENTS

225g [leaven](#)

850g water for the dough

500g strong white roller-milled flour

500g stoneground wholegrain flour

20g fine sea salt

› **SUGGESTED STARTER** White or wholegrain or rye

› **SUGGESTED METHOD** Retarded

We teach three versions of our classic formula. This is the second version. It is halfway between the School's classic sourdough loaf, which is just 20% wholegrain flour, and the 100% wholegrain version. It is made using 50% wholegrain and 50% white flour, and the result is lighter than wholegrain, whilst still offering much of the wholegrain flavour and nutritional benefits. This formula needs slightly more water because it is wholegrain and the bran takes up more of the water.

You will notice subtle differences between this dough and the classic 20% sourdough even with just a relatively small percentage change in the ratio of wholegrain flour to white. It will ferment slightly faster, the crumb will be moister and the sour flavour will be more pronounced.

Advice

- Keep in mind that the more wholegrain flour there is, the faster the dough ferments. This is especially noticeable when using British or northern European flours, as in a maritime climate grains tend to have higher levels of enzymes than grain from hotter climates where enzyme activity, broadly speaking, is lower. (There is more about wholegrain flour in the next formula of 100% wholegrain.)

- We often encourage students to experiment when it comes to the kind of wholegrain they use. If you use a slightly higher protein white roller-milled flour this can help prop up lower protein flours, such as einkorn, emmer, spelt or Øland flour. This balances out the overall gluten levels, compensating for the lower levels of protein found in these wholegrain flours. It means that the loaf will still be beautifully robust and rise well during baking; this 'propping-up technique' is one we often use to achieve higher sprung loaves whilst still using local or heritage wholegrain flour.



Classic 50:50 wholegrain/white sourdough boule

Classic: wholegrain sourdough boules

A good wholegrain sourdough loaf has a robust crust and a tender crumb. Made with 100 % wholegrain, sourdough can be a more challenging loaf to bake, and many students who have attempted wholegrain loaves before they attend the School express frustration that their bread hasn't turned out the way it should. But wholegrain is worth persevering with, not least because it has buckets of flavour and nutrition. Baking a consistently good wholegrain sourdough is easier to achieve when you understand why there are pronounced differences between flours. The two main considerations are the levels of bran and enzymes. Both affect your bread.

HOW THE MILLING PROCESS AFFECTS THE FLOUR

- The way in which flour is milled and sifted affects the quantity and texture of the bran. Large particles of fibre can interrupt the gluten network of your dough and so compromise the structure of the crumb. There may also be marked differences in the openness of the crumb between stoneground wholegrain bread and one made with roller-milled wholegrain flour. In general, the finer the wholegrain flour is milled the less the bran interrupts the gluten network.
- Stoneground flour is also digested more slowly. Studies on sourdough made with stoneground flour have indicated that the rate of assimilation for carbohydrates is slower than any other bread, making this a great loaf for anyone who needs to monitor or slow down blood sugar levels, such as athletes or [diabetics](#) (see for more info on blood sugar).

HOW ENZYMES AFFECT THE RATE OF FERMENTATION

- Using wholegrain flour really tests the baker because the fermentation of the dough is far more responsive when all the enzymes and nutrients are available to the microbes. I often compare it to driving a Formula 1 car when you have just passed your driving test – the dough can run away with you. Different wholegrain flours are also milled using different grains that grow in different climates and are then milled using different techniques. This becomes more relevant when you know that different grains also have varying levels of naturally occurring enzymes, which are affected by the humidity of the country or region in which they are harvested.
- Northern European countries have climates with higher humidity levels, so generally produce grains with higher levels of enzymes. When this grain is milled the sugars are broken down faster, with the result that dough made with this kind of flour ferments faster. As more sugars are available to the lactic acid bacteria they produce more acid, which results in higher levels of acidity in the dough, especially if left for too long. It is especially important when using European wholegrain flour to keep a close eye on the timings as the dough can easily over-ferment. When this happens the acidity compromises the gluten network, giving you a sour-tasting loaf.
- The lower humidity levels of parts of Canada and the USA, for example, results in a very dry harvest and has the opposite effect on grain grown there. When there are very few enzymes in the grain there is limited availability of sugars for the yeast to use, which slows fermentation. Sourdough made with low enzyme flour ends up underproved, pale and as heavy as a brick because the microbes don't get enough food and the sugars are very quickly used up.

WHY DO DIFFERENT FLOURS BEHAVE DIFFERENTLY?

- Large mills auto-adjust their bread flour, so it is a matter of simply finding flour you like and getting to know it. If possible I recommend that home bakers make contact with their local artisan mill. If you can, visit the mill, find out more about the flour, and ask the miller about the Hagberg number – a measurement that indicates the levels of enzyme activity in the flour. Ironically the higher the Hagberg number the lower the enzyme

Alpha-amylase, which can be hard to get your head around. Typical Hagberg numbers in the UK and northern Europe might vary from 200 to 400.

- Hagberg numbers on a dry summer harvest or from countries with a continental climate, can end up with a Hagberg number over 400, which makes flour low in enzymes. For this kind of flour the mills have to adjust the enzyme levels or add malt; however in other countries the rules vary and adjustments are not allowed.

PROTEIN LEVELS ARE DIFFERENT

- In northern Europe generally sunshine levels are lower. The amount of protein in flour is directly proportional to the amount of sunshine the plant gets, and so there are slightly lower protein levels in flour grown in temperate Europe. What we lack in quality of protein, though, we seem more than able to make up for in flavour with more sugar being available. This is of course a generalisation, but I think that it is a reasonable one to make, so you may need to get to know the optimal level of hydration so, as with all the formulas, the water may need slight adjustment according to the levels of protein of the flour you choose to use. In the end it is about getting to know your flour. Familiarity with your flour makes it easier to understand the small nuances of the baking process, which will make you a better baker.



Classic: wholegrain sourdough boules

Classic: wholegrain sourdough boules

MAKES 2 LARGE BATARDS OR BOULES › 90% HYDRATED › LESSON LEARNING TO WORK WITH WHOLEGRAIN FLOUR

› INGREDIENTS

225g [leaven](#)

900g water

1kg strong wholegrain flour

24g fine sea salt

› INCLUSIONS

20g olive oil

› SUGGESTED STARTER Any, but for maximum sourness and digestibility use rye or wholegrain.

› SUGGESTED METHOD Retarded. This gives time for the bacteria to produce organic acids, which contribute to both flavour and digestibility.

Advice

- One of the things that can really help result in a stronger dough when making wholegrain bread is to extend the Mix & Autolyse step without the leaven. It gives time for the bran to soak up the water and softens it, which in turn does less damage to the gluten network as you mix. An hour or so will make a real difference.

- Generally I suggest that this is a loaf that is best refrigerated for 18 to 24 hours, however for those looking for maximum digestibility you can refrigerate this for a further 12 hours – your loaf will have higher acidity and slightly less ‘oven spring’.

- Stoneground wholegrain can sometimes be tricky to judge. When you first mix the dough it looks as though there is not enough

water, but after half an hour or so the flour will have had chance to absorb the extra water. You will need to be patient and get to know your flour. Because wholegrain flour is full of nutrients and enzymes with plenty of food available to the microbes it ferments more quickly than white flour, so you will need to reduce the bulk fermentation and perhaps shorten the final prove. You need to become familiar with your flour and get used to the rate at which it ferments, which means practising and using the [loaf record](#) sheet to assess your dough and make any changes to the schedule if needed.

- Whilst all of the loaves in this book have been hand mixed, if you want full gluten development I suggest that you mix this dough in the [mixer](#), for further advice.) If you can get a spiral mixer, then even better because the movement develops the gluten more than a planetary mixer (which is what most domestic mixers are).

- You will notice I added a touch more sea salt here – this will help develop the gluten. It's just a few grams, but it does make a difference.

- A small amount of olive oil in the dough will allow a fraction more extensibility of the gluten.



Classic: wholegrain sourdough boules

100% heritage sourdough in a tin

MAKES 2 LARGE LOAVES ABOUT 1250G EACH OR 4 LOAVES BAKED IN TINS ABOUT 620G EACH › HYDRATION 87%

LESSON HERITAGE GRAINS AND USING A TIN TO SUPPORT THE LOAF TO EXTEND THE FERMENTATION TIMES

› INGREDIENTS

225g [leaven](#)

Again, if you suspect you can tolerate heritage grain but not modern varieties then use heritage flour to make your leaven.

875g water for the dough

1000g stoneground wholegrain 'heritage grain' flour, such as einkorn, emmer, spelt, kamut® or durum

20g fine sea salt

› INCLUSIONS

200g seeds such as pumpkin, sesame, linseed or sunflower seeds

OR

200g sprouted heritage grain such as spelt, einkorn or emmer (see for [sprouting](#) instructions)

› SUGGESTED STARTER Rye or wholegrain

› SUGGESTED METHOD Retarded (and, if you have digestive issues, an extended retarded prove of 24–36 hours). I also

recommend a 12 hour pure Autolyse in the fridge.

If I suspect a student has digestive issues relating to modern wheat (see [here](#) for more on this), I suggest they try a long, slow-fermented heritage grain made in a tin, as many students report that they find heritage grains easier to digest. That said, don't be put off baking this loaf on the grounds that you don't have digestion issues, because the deep, nutty, sweet, complex flavours are an absolute knockout.

There are several reasons for using a tin. Firstly, heritage grains often have a more complex gluten structure than modern wheat varieties, and as a result these ancient flours can be challenging, especially for a beginner, to make into a boule. Secondly, heritage grains grown in a maritime climate have more enzymes. Their activity massively boosts the amount of sugars made available from the wholegrain flour, and so increases the amount of acid the bacteria produce. Being coupled with a long, slow, cold prove and a rye starter pushes the acidity levels as high as possible, which break down the gluten matrix, so the tin helps to support the loaf as it proves. It is not essential to ferment this loaf using a long, slow prove, but if you like a really sour loaf, or you have digestive issues, this is the key component in lowering the pH levels and so potentially making this bread more easily digestible.

There is no need to stretch and fold this loaf more than once – just mix the bassinage water in thoroughly. Also omit scoring.

Advice

- ▀ **Pre-soaking the seeds aids digestibility. Toasting the seeds is optional – this increases the flavour and stops enzyme activity.**
- ▀ **Use butter to grease the tin and dust with flour to stop this loaf from sticking to the tin.**
- ▀ **I've suggested 875g water, but depending on the water content of your seeds you can use more. With dry toasted seeds you increase this to 1000g of water.**



100% heritage sourdough in a tin

Russian rye bread

MAKES 2 LARGE 1200G BOULES OR 3 MEDIUM 800G BOULES › HYDRATION 75%

LESSON USING UP THE DISCARDED STARTER BY MAKING A RYE BREAD

› INGREDIENTS

750g [leaven](#) or leftover discard from your starter

750g water for the dough at 77°C

1kg wholegrain rye

24g fine sea salt

› INCLUSIONS

10g charcoal powder, optional

3 tablespoons lightly toasted coriander OR caraway seeds

50g black treacle

› **SUGGESTED STARTER Rye**

› **SUGGESTED METHOD Ambient or retarded**

This dark, moist, treacly bread has a distinctively Russian character and is best left for two days before eating to really develop the flavours. We serve it toasted, topped with thick slices of beetroot-cured salmon and soured cream, sprinkled with dill.

The method used to make it differs from the classic method of sourdough in several ways and is actually much simpler:

- › The leaven is made up of leftover sourdough starter so there is no need to make leaven.
- › There is no need to stretch and fold the dough because rye flour lacks gluten to develop and the technique relies on gelatinisation.
- › The shaping involves literally just squidding the dough together and popping it in a well-floured banneton. You just need to use a generous dusting of flour to stop your hands from sticking to the dough.
- › The flour is scalded using hot water

WHY SCALD THE FLOUR?

Amylase enzymes naturally present in the dough peak at 77°C, so scalding milled wholegrain rye, which is rich in natural amylase, kills off any naturally present yeast and bacteria. This creates a sweeter bread because the amylases are not killed, so as the dough cools they are free to convert the starches to simple sugars. When, 3–5 hours later, the leaven is added, there is more sugar available. This increases the contrast of sweet and sour flavour and is very typical of Russian-style rye breads.

Advice

- › **Instead of making a leaven, use 700g of starter that is between 1 day and 1 week old, made up of accumulated starter discard. If older than this, it can become too sour to use. We keep the leftover starter in a separate pot in the fridge ready to make this bread.**
- › **Occasionally, depending on the flour you use, the dough may need a little more water. If this is the case, first mix what you have and then add just 10g more at a time, giving the dough time to absorb it. I have used some rye flours that can take up to another 200–250g.**
- › **This is a very thick sticky dough. I advise using a dough hook on a sturdy stand mixer to mix.**
- › **There are two significant adjustments to the timings and schedule: Firstly, the initial autolyse is WITHOUT leaven for 4 hours. Maintain the dough temperature at 28°C. Another tip is to remove the leaven from the fridge when you scald the flour to allow it to come up to room temperature.**
- › **Add the salt and any inclusions at the same time as the leaven.**
- › **Once the leaven is added, the bulk ferment temperature should be allowed to drop to 22–24 °C – this is just a matter of leaving the dough on the side at room temperature.**
- › **To further intensify the flavours, you can smoke this bread by using a tablespoon or two of coriander seeds. See for [smoking](#) method.**



Russian rye bread

Seeded sourdough boules

MAKES 2 LARGE BOULES OR 3 BATARDS › HYDRATION 85% › LESSON **ADDING SEEDS TO SOURDOUGH**

› INGREDIENTS

225g [leaven](#)

850g water for the dough

700g strong white flour

300g stoneground wholegrain flour

20g fine sea salt

› INCLUSIONS

300–400g seeds, EITHER toasted lightly OR pre-soaked overnight

200g selection of seeds to roll the dough in, two-thirds of which will be returned to the pot

› **SUGGESTED STARTER** Any, but for maximum sourness and digestibility use rye or wholegrain.

› **SUGGESTED METHOD** Retarded. This gives time for the bacteria to produce organic acids, which contributes towards the breakdown and digestibility of both the seeds and bread.

When it comes to seeds, the sky is the limit. They provide the chance to layer more texture, flavour and nutritional values into your loaf, for next-to-no effort. You can either add them into the dough, or simply roll your dough in them as you do the final shape.

We have a huge collection at the School: golden linseeds, flaxseeds, dark green pumpkin seeds, sunflower seeds, fragrant sesame seeds, chia seeds and amaranth seeds, to name just a few. Certain seeds combine well with particular flours. Sunflower seeds and spelt, for instance, have a natural affinity. It is worth noting that this is the same technique used to add malted flakes

HOW TO ADD SEEDS TO THE OUTSIDE OF YOUR LOAF

If you want seeds on the outside of your bread you will need about 200g to get decent coverage, though the dough won't take up all of them. The best way to do it is to put the seeds on to a wet tea towel that has been wrung, to dampen the outside, then transfer them to a shallow-lipped plate and, just before you would transfer the dough into the banneton, very gently roll the dough in the seeds. As you transfer the dough to the banneton, close the dough as if you were closing a book, to increase the tension and distribute the seeds. You can, of course, scatter some seeds into the bottom of the banneton, but this technique distributes them more easily. Sift and return any remaining seeds to a pot. There is usually about two-thirds left to use next time.

Advice

- You can use dry seeds, but when soaked overnight and drained thoroughly they are even more moist and delicious. At the School, we also like to toast seeds lightly to give a lovely nutty flavour.
- Soaking the seeds overnight certainly seems to increase ease of digestibility and adds to the open texture in the dough. This is recommended for the ambient method. Dry seeds tend to soak up some of the water, effectively lowering the available water to the dough and can result in a tighter crumb structure. To compensate for this you can add another 20g of water. I recommend this for the retarded method.
- It is best to add the seeds in during the stretch and fold process, that way there is minimal interruption to the gluten network.



Seeded sourdough boules

Blackberry, poppy seed & pea flower water bread

MAKES 2 LARGE BOULES ▸ HYDRATION 80% ▸ LESSON PH CHANGES AS THE DOUGH ACIDIFIES

▸ INGREDIENTS

225g [leaven](#)

800g tea for the dough (see below)

850g strong white flour

100g wholegrain flour

50g rye flour

20g fine sea salt

▸ INCLUSIONS

200g blackberries or blackcurrants

100g poppy seeds

20g toasted aniseeds, optional

[Honey soy glaze](#), optional

▸ **SUGGESTED STARTER** Any, however rye will give a great base flavour and deepen the colour.

▸ **SUGGESTED METHOD** This is one to try using each of the different starters and each of the different methods to see the variation between the loaf colours. Using a retarded method with rye leaven accentuates the flavour of the berries in this bread and deepens the colour, but using a white starter and an ambient method will give you a lighter coloured and flavoured loaf.

› **MAKE THE BUTTERFLY TEA** Brew 2–3 heaped tablespoons of butterfly pea flowers in 800g of hot water just off the boil, in the same way as you might make a pot of tea. Leave to cool, strain and then warm to the temperature needed to create your ideal dough fermentation temperature.

The appearance of food and the desire to eat it are indisputably connected, and this loaf is a real showstopper. The dramatic blue crumb is achieved by using butterfly pea flower tea in place of water. The tea is made from a Southeast Asian flower which turns the dough an amazing colour without affecting the flavour. When the ambient method is used, you will get a midnight–cobalt blue crumb, but if you develop the acidity of the dough more using the retarded method, it transforms the bread into a rich violet colour.

It is an amazing way to demonstrate that the length of fermentation and the resulting changes in pH affects more than just the taste in the loaf. It's as though the loaf is a giant litmus paper; as the pH increases the colours deepen to purple.

We grow our own blackberries and blackcurrants in the School gardens and the deep blues and purples set off the berries and poppy seeds beautifully. The option to include toasted aniseeds and a honey soy glaze means that you can match the flavours to the intensity of the colour if you want to.

Advice

- › **The more butterfly pea flowers used in the tea, the darker the loaf.**
- › **White roller-milled flour best shows off the colour, though sometimes lacks the complexity of flavour I like in my bread, so if you want to layer in more flavour, add 20g of toasted aniseeds to the dough and mist the loaf with a honey and soy glaze.**
- › **HONEY SOY GLAZE** mix 2 tablespoons of dark soy sauce and 2 tablespoons of runny honey with 2 tablespoons of water. This quantity will mist four loaves and stores in the fridge for a month. mist the loaf lightly using a reusable spray bottle 2–3 minutes before the bread finishes baking.



Blackberry, poppy seed & pea flower water bread

Wild garlic boules

MAKES 2 BOULES › HYDRATION 77% › LESSON **ADDING A PASTE**

› INGREDIENTS

225g [leaven](#)

775g water for the dough

800g strong white flour

200g wholegrain flour

20g fine sea salt

› INCLUSIONS

For the herb butter

A large handful of wild garlic leaves, plus extra to decorate

100g ghee or unsalted butter

A large handful of grated hard cheese such as Parmesan

Coarse sea salt and ground black pepper, to season

Chop the wild garlic directly into a mortar in 2mm lengths using scissors, then add the butter and mix thoroughly. Stir in the cheese. It should be thick enough to spread easily. Season with salt and pepper. To store, cover and keep in the fridge for up to a week.

› **SUGGESTED STARTER** Any

› **SUGGESTED METHOD** Ambient or retarded

In April, the garden at the School comes alive. The birds sing their hearts out and the cherry trees are laden with blossom. The wild garlic, with its pretty, star-shaped flowers, is tucked under an ancient beech tree at the bottom. Making a herb butter with it is a wonderfully easy way to get a rich, full-flavoured sourdough bread. I love to use a pestle and mortar rather than a blender, simply for the joy of it: I cannot deny myself the satisfaction of crushing the ingredients together. The butter is added to the centre of the dough on its final shaping and trickles and oozes through the bread as it bakes.

Advice

▸ **Wild garlic is only in season for a couple of months of the year, so if you can't find any or when it is out of season use oregano, marjoram, coriander, parsley, sage or a herb of your choice. Or use lemon or orange zest and cinnamon at Christmas.**

▸ **Be absolutely certain that what you are using is wild garlic – it looks remarkably similar to poisonous plants such as lily of the valley. It should smell like garlic, but if in any doubt do not use.**

▸ **Don't be tempted to overload the boule with paste, and make sure all the butter is inside the boule. Don't overdo the shaping or it will burst out of the sides.**

▸ **Line the banneton with wild garlic leaves and any flowers for a very pretty effect.**



Wild garlic boules

ADDING THE HERB BUTTER TO THE DOUGH

Open the dough flat and put a good tablespoon or two of the butter on top. Spread out, leaving 5cm around the edges without butter.

Fold down each edge so that all the butter is inside.

Shape by first stretching the dough from the bottom up. Then pull the sides of the lower half together, followed by the sides of the upper half, and then pull the top down before rolling it down. Create tension in the dough by drawing it gently back against the table top and then drop in the banneton.

Turn over.

Place the reserved leaves in the banneton.

Dust the banneton well.

Stitch if you can see any butter by pulling the dough together to seal the butter in.





Jalapeño & cheese loaf

MAKES 2 LARGE BOULES OR 3 BATARDS › HYDRATION 80%

LESSON USING CORN AND MAKING THE BREAD THE CENTREPIECE OF A MEAL

› INGREDIENTS

225g [leaven](#)

20g olive oil

800g water

700g strong white flour

200g sifted wholegrain flour

100g cornmeal (maize)

10g [malt](#) powder

18g fine sea salt

› INCLUSIONS

6 jalapeño peppers preserved in oil, chopped

200g strong cheese such as Cheddar, grated

› SUGGESTED STARTER Any

› SUGGESTED METHOD Ambient – I love a sweet milky-flavoured loaf that allows the cheese and heat to take centre stage.

Often we think of bread as an addition to a meal, but with inclusions it can also be the centrepiece. This Mexican inspired loaf was made by one of our students, Phil, and was so good that it had to be included. There is real joy in seeing our students go on to create their own amazing breads.

The jalapeño peppers are added at the last stretch and fold. In general, they are mild, but packed full of flavour. Occasionally, though, you get a rogue one that is super hot, which is part of the fun of eating them, I guess!

Advice

› Cornmeal can come in many different grades, from fine to coarse and stoneground or roller-milled. This will affect the texture and the amount of water it will soak up, so it is worth trying a few to see which one you prefer.



Jalapeño & cheese loaf

Olive and pickled lemon butter bread

MAKES 2 LARGE 1190G BOULES OR 3 X 795G BATARDS OR BOULES › HYDRATION 80%

LESSON CONTROLLING SOURNESS, FLAVOUR

› INGREDIENTS

225g [leaven](#) - a rye leaven will give you a more sour flavour

800g water

800g strong white flour

200g wholegrain flour

15g fine sea salt

› INCLUSIONS

200g stoned olives

100g cultured butter

3 pickled lemons, very finely chopped rind only

8–10g pink peppercorns, crushed

4 juniper berries, finely chopped

› SUGGESTED STARTER White or rye

› SUGGESTED METHOD Ambient, using a white starter for a fresh sweet loaf, or retarded with a rye leaven for increased sour tang.

These robust, tangy ingredients make for an intense yet harmonious flavour combination, and a loaf that really lends itself to being the centre of a Mediterranean feast. I love it with soft goat's cheese, Parma ham and a bottle of fresh crisp white wine.

LAYERING IN FERMENTED INGREDIENTS

Like sourdough, pickled lemons and olives are both fermented, and like any good partnership they bring out the best in each other, emphasising the sourness, salty brininess and aromatic flavours. The original inspiration came to me whilst churning our cultured pickled lemon butter that we serve for lunch. The bread can take more flavour than the butter can, so I've used the same ingredients but added more of the pickled lemon. Juniper berries bring complex but subtle aromas, as do the pink peppercorns, which I love as they are so exquisitely fragrant.

This bread is perfect for learning how to control flavours. When deciding how sour you want it to be you need to choose between starters and

leaven. Our original, homofermentative, French starter, which is lactic and sweet, makes a young, fresh loaf when fermented ambiently that highlights the lemony flavours. When I want to emphasise the sourness of the loaf, I use a rye starter and add about 50g of grated Parmesan to the butter, which adds a rich umami flavour. I prove this slowly for 24 hours using the retarded method. Both versions are good, and part of the fun of developing your understanding of sourdough is playing with flavour development, and discovering what you like.

Advice

The salt in the bread has been reduced slightly as both the olives and the lemons are salty. Only use the rind when chopping the lemons, as the lemons themselves are too acidic and can affect the gluten structure.



Olive and pickled lemon butter bread

Tomato & herb bread

MAKES 3 X 780G MEDIUM OR 4 X 590G SMALLER BATARDS › HYDRATION 80% (not including tomato purée)

LESSON **BLENDING DURUM WHEAT SEMOLINA TO CREATE THE TEXTURE OF A TYPICALLY ITALIAN STYLE BREAD WITH TOMATOES**

› INGREDIENTS

225g [leaven](#)

800g water for the dough

700g strong white flour

300g durum wheat semolina

20g fine sea salt

› INCLUSIONS

For the tomato and herb paste

200g sundried tomatoes, chopped

50g tomato purée

3 garlic cloves, chopped and lightly sautéed

6 x 2.5cm stems of fresh oregano or 2 heaped tablespoons of dried herbs

1 tablespoon ground black pepper

50g finely grated Parmesan

Pat the sundried tomatoes lightly with kitchen paper to remove the oil. Add the tomato purée, sun-dried tomatoes, garlic, oregano and Parmesan to the dough by smearing the bread with the purée and scattering the rest of the inclusions on top of this at the final shaping stage.

› SUGGESTED STARTER Any

› **SUGGESTED METHOD** Any

Not everyone likes adding things to their bread, but it's worth trying this out. It doesn't take much to transform a humble loaf of bread into the centrepiece of a meal. The addition of the durum wheat semolina to this loaf adds a gorgeous texture reminiscent of altamura bread from Bari in southeast Italy and I am unapologetic in my greediness when it comes to this loaf. It's the sort of bread to pull apart with your hands and eat at a table laden with cheese and wine. I love to breathe in its sweetness, but I can't stop there. The aroma is so good that I will wipe chunks of it across my plate, saturating each one in the vinaigrette from a summer salad, enjoying every mouthful.

This formula uses sun-dried tomatoes, their intense flavour matching that of the oregano. We grow several kinds of oregano at the School and in summer it fills the air with its perfume, which has a natural affinity with tomatoes. The tomato purée and herbs are added at the last possible moment, so that the acidity of the tomato paste and the natural antifungal properties of oregano do not inhibit dough development.

Advice

- › **Check that your tomato purée is not too acidic. There is not a measure for this, so you will have to rely on your sense of taste to find a sweet one.**
- › **Use a tablespoon of the semolina scattered on the baking surface as you turn out the dough, to create a bit more texture.**
- › **Durum adds texture and flavour, but it can suck up a lot of the water. If you find this to be the case, increase the water incrementally up to another 70g.**

Scandinavian buttermilk sourdough

MAKES **2 LARGE LOAVES OR 3 BATARDS** › **HYDRATION 85%**

LESSON **SAVOURING SOURDOUGH AND USING BUTTERMILK TO BAKE WITH**

› **INGREDIENTS**

- 225g [leaven](#)
- 850g buttermilk for the dough
- 500g strong white flour
- 500g heritage wholegrain such as einkorn, emmer or Øland flour
- 20g fine sea salt

› **INCLUSIONS**

- 20g lightly toasted caraway seeds

› **SUGGESTED STARTER** Rye or wholegrain or chocolate.

› **SUGGESTED METHOD** Any method

A Nordic-inspired loaf, this is made using 50% wholegrain flour, which I mill literally seconds before adding it to the dough. It also combines toasted caraway and lightly acidic cultured buttermilk, which I make myself; often this has a few missed bits of butter in it, which adds extra richness to the bread and softens the crumb.

I first came accross Øland, a Scandinavian heritage wheat flour, in a bread baked by Rasmus Kristensen at Noma in Copenhagen. The flavour of the sweet, moist and rugged bread he made stayed with me, as did the restaurant's approach to serving it. Diners were given just a small slice, as they knew this would mean the customers would take the time to savour it, almost as though it were a fine wine. I love this idea of taking the time to appreciate something humble. So often bread is put on the table and taken completely for granted. It is a thought that has stayed with me ever since; savour your bread, slow down, breath deeply and just lose yourself in the delicate, complex, wheaten, malted, honeyed, sour and sweetness.

Despite that fact that I play with flavour and layer aromas by using various flours and ingredients throughout my baking, in the end it is the addition of wholegrain and the long slow fermentation that I find are the keys to getting the best flavour.

Advice

Commercially made buttermilk doesn't have the same richness that my buttermilk brings to this formula, so if you buy your buttermilk you will need to add about 20g of butter to it.

**Sweet berry bread with rosewater
served with crushed fermented berries**

MAKES **2 LOAVES** › **HYDRATION 55%** (egg and butter inclusion increases overall hydration to approximately 77%)

LESSON **ENRICHED SOURDOUGH**

› **INGREDIENTS**

- 225g [leaven](#)
- whisk together for the dough:**
- 120g water
- 400g milk
- 2 large eggs
- 125g melted butter
- 650g strong white flour
- 350g wholegrain flour
- 20g fine sea salt

› **INCLUSIONS**

300g fruit such as strawberries or blueberries, lightly crushed

30g rosewater (optional) for misting (see recipe below)

› **SUGGESTED STARTER White**

› **SUGGESTED METHOD Either ambient or retarded are fine**

This bread, which has more of a cake consistency, is an enriched, sweeter sourdough made with butter and eggs. I often talk about layering fermentation and flavours, so we serve it with crushed fermented strawberries (from early summer, parts of the garden are covered in wild strawberries), tart cultured cream and kvass made with summer fruit. It is best when lightly sour, so I recommend using the ambient method to get the most lactic flavour possible.

Serve with soured cream and fermented berries. Simply mix together about 300g of berries and cover in a live ferment, such as water kefir or fruit vinegar, with a small amount of sugar and leave overnight. Drain well, crush with a fork and sprinkle with caster sugar.

› **FERMENTED ROSEWATER**

In the summer we make fermented rose water at the school, with which we mist this loaf just as it comes out of the oven.

10–15 red or pink rose heads, unsprayed

1 cardamon pod, crushed

400g water

100g sugar

Separate the petals and rinse lightly. Place in a saucepan with just enough water to cover (no more, or you'll dilute the intensity of their flavour). Cover and simmer for 10–15 minutes or until the petals have lost their colour. Strain and discard the petals. Return the liquid to the pan and reduce it by just over half so you have about 200g of liquid. Stir in the sugar. Cool and transfer to a sterile glass jar with a lid. It will keep for about 6 months in the refrigerator.

Advice

› **Add the salt at the same time as the liquid.**

› **There is no need to stretch and fold.**

› **This bread only needs one shape even when using the retarded method.**

› **Drop the oven temperature with this bake to 190°C/gas mark 5. This needs to be more cake-like, so remove from the oven when lightly golden about 10 minutes earlier than the master method timings. If you want a soft crust wrap it in a clean tea towel as it cools.**



Sweet berry bread with rosewater served with
crushed fermented berries

Chocolate & roast hazelnut bread

MAKES 2 LARGE OR 3 MEDIUM BOULES › HYDRATION 83% (porridge consistency will impact overall hydration by approximately 10% either way) › LESSON CHOCOLATE STARTER AND SWEETENING SOURDOUGH WITH RAISINS

› INGREDIENTS

225g [leaven](#)
830g water for the dough
800g strong white flour
200g wholegrain flour
80g cacao
15g roasted barley [malt](#)
20g fine sea salt

› PORRIDGE

100g dark chocolate, 80% cocoa solids, melted
70g oats
230g water (or more if needed)
200g chopped toasted hazelnuts OR
300g sultanas, soaked in warm water overnight and drained well

› SUGGESTED STARTER Chocolate or white (French)

› SUGGESTED METHOD Any, though the ambient method encourages a more lactic, sweeter-flavoured loaf.

› A SEASONAL TWIST At Christmas, you could combine the grated zest of an orange, 2 tablespoons of whisky and a tablespoon of honey mixed with 2 tablespoons of water. Bring it to the boil, then strain and transfer to a spray bottle. About 2 minutes before the end of baking use this to mist the loaf, then return to the oven. This gives the loaf a beautiful shine. It is not so much a flavour as an aromatic suggestion on the outside of the crust.

Chocolate and roast hazelnuts are a classic combination, but we also make a sweet version of this bread with plump, juicy sultanas.

Many people don't realise that flavour of chocolate is dictated, to a certain extent, by the fermentation process. There is a natural synergy between fermented foods and I like to use a chocolate starter for this bread, which is likely to contain microbes that were involved in the breakdown of the cacao, as it adds complexity and bittersweet cacao notes. Studies show that a range of homofermentative lactic acid bacteria is involved in the breakdown of cacao, as the temperature of cacao fermentation is very warm. This starter should, therefore, give you a lovely milky-flavoured bread.

The sourness is perhaps lost until the loaf is a few days old, but it rarely lasts that long! I sometimes grate in a little nutmeg on the last stretch and fold, largely because I associate chocolate with the Caribbean, and in particular with the island of Grenada, which is where we source the chocolate we use at the School. It's a good combination.

We serve this bread with sweet cultured butter whipped with icing sugar and cacao (to taste).

Advice

- If you prefer a sweeter version of this loaf, substitute the hazelnuts with 200g of soaked and drained sultanas.
- Adding sultanas can increase the sugar in the chocolate porridge, which can significantly increase the rate of fermentation, even though it is added at the last moment, in the last stretch and fold. Keep an eye on the dough, as you may need to shorten the bulk fermentation to compensate.



Chocolate & roast hazelnut bread

Rosinbrød

MAKES 2 LARGE BOULES › HYDRATION 82% › LESSON SWEETENING SOURDOUGH

› INGREDIENTS

225g [leaven](#)

825g water for the dough

600g strong white flour

300g wholegrain flour

100g rye flour

20g fine sea salt

› INCLUSION

BUTTER SPICE PASTE

85g unsalted ghee, or very soft butter

60g soft brown sugar

1 teaspoon vanilla extract

2 teaspoons ground cinnamon

½ teaspoon freshly grated nutmeg

400g sultanas

Mix the butter, sugar and spices, then stir in the sultanas.

› **SUGGESTED STARTER** Rye or wholegrain

› **SUGGESTED METHOD** Either ambient or retarded is fine

This Scandinavian-inspired loaf has all the elements you would expect in a traditional rosinbrød – or raisin bread. It is dark, sweet, rich and fragrant, with a small amount of rye and a buttery spice paste that oozes and trickles through the centre of the dough as it bakes – the smell from the oven is unbelievably good. It's excellent when it is a few days old, in large, lightly toasted hunks spread with cold butter and served with a pot of tea.

We tend to use ghee instead of butter to make the paste, as it has a higher smoke point. If you use butter, it can burn if any escapes as the bread bakes.

Advice

- › There is extra sugar in this bread from the paste and the raisins, so you will need to keep an eye on the bake time – check it 10 minutes early and remove from the oven if it has reached a light golden tan colour.
- › Although there is a high level of hydration the sultanas soak up a good deal of the water, as do the wholegrain and rye flours, so this bread has a moist, slightly denser crumb structure. Choose moist, plump sultanas, as they will require less water to hydrate them.
- › Make sure your paste is smooth and easy to spread. Smear over the dough at the point where it is at its most open as it is shaped.
- › See [Wild Garlic Boules](#) for step-by-step instructions for adding the butter spice paste.



Rosinbrød

Beetroot, black pepper & feta batards

MAKES 3 MEDIUM BATARDS ABOUT 815G EACH OR 4 SMALL BATARDS ABOUT 610G EACH › HYDRATION 70% (depending on dehydration level of beetroot) › LESSON USING PURÉED VEGETABLES IN PLACE OF WATER

› **INGREDIENTS**

225g [leaven](#)

100g water

750g beetroot purée for the dough (see recipe below)

800g strong white flour

200g rye flour

20g fine sea salt

› INCLUSIONS

400g feta, chopped into 2.5cm cubes

1 teaspoon cracked black pepper

› **SUGGESTED STARTER** Any, but for maximum depth of colour, sourness and digestibility use rye or wholegrain.

› **SUGGESTED METHOD** Retarded, again for depth of colour. This method gives time for the bacteria to produce organic acids, which contribute to the deep purple colour and to flavour and digestibility.

› BEETROOT PUREE

4 large beetroots, washed and dried

15ml olive oil

Rub the beetroots with olive oil then wrap them in a piece of foil, place on a baking tray and roast at 220°C/Gas mark 7 for 1 hour or until soft. Remove from the oven and allow to cool. Keep the skins on. Liquidise in a blender, adding a little cold water if needed, until you have a purée about the same thickness as apple sauce. Use to make the dough when it reaches 28–30 °C.

When I began playing with beetroot, I wasn't convinced it brought anything other than a red colour and an earthy flavour. My opinion changed when I threw in a little tangy feta and a good pinch of fragrant black pepper. These bring out the gentle sweetness of the beetroot, pushing any traces of earthiness into the background so it becomes a partner in a wonderfully creamy, salty and peppery mix. When fermented slowly using the retarded method, the increased acidity levels of the dough help to preserve the colour in the bread. This is especially pronounced when using a (heterofermentative) rye starter because it encourages the production of acetic acid. A very long, slow prove – 24 hours in the fridge – also increases the intensity of the colour.

Advice

› Beetroot isn't to everybody's taste. If you are a gardener and want to grow your own for this formula, botanist James Wong recommends the variety 'Detroit Dark Red' because it has a less earthy flavour.

› Pumpkin will produce similar results and give a wonderful orange colour. You might need to adjust the thickness of the purée – it should be pourable.

› You can add thin slices of beetroot just as you shape the dough, which will result in deep purple flecks of colour in the crumb.

› Shaping a batard is almost exactly the same as making a boule. Once you've formed your boule, rest it for a minute to allow the gluten to relax, then dust the top with a small amount of flour and put your hands into the middle of the bread. Rock gently back and forth, keeping the seam underneath to form two fat cylindrical shapes with tapered ends. Prove either on a couche (a linen fabric specially made for bread making) or a heavy-duty cotton tea towel.



Beetroot, black pepper & feta batards

Earl Grey, fig & kamut® loaf

MAKES 3 BATARDS › HYDRATION 80% › LESSON SHAPING A BATARD AND BAKING WITH KHORASAN FLOUR

› SCHEDULE

225g [leaven](#)

800g Earl Grey tea

500g kamut® flour (wholegrain)

500g strong white flour

20g fine sea salt

› INCLUSIONS

6–8 fresh figs OR 150g dried figs, soaked overnight and drained

Finely grated zest of 1 large organic unwaxed lemon, to be added on the last stretch and fold

30g organic polenta or cornmeal, for dusting

› SUGGESTED STARTER White

› SUGGESTED METHOD Either ambient or retarded

Khorasan is an ancient wheat that originates from the Fertile Crescent that includes Afghanistan and Iran. The grains, which have a beautiful distinctive amber colour and a slightly glassy appearance, are double the size of most wheat, and produce a wonderful, buttery, textured yellow flour. They are also characteristically hump-shaped, and so have the nickname ‘camel’s tooth’. Khorasan is known by the commercial name kamut®.

It grows strikingly tall, with golden ears and long, black, whiskery awns. I’ve grown some in my garden, and while the plant is perhaps slightly compromised by the lack of sunshine, it is, nevertheless, well worth saving a few grains and planting them in a sunny spot just for the joy of seeing how beautiful it is.

The bergamot in the Earl Grey tea and lemon are gorgeously aromatic and echo the eastern flavours of the flour. Khorasan can be a very thirsty flour so some flours need another 50g of water.

Advice

• Depending on the time of year, use either fresh or dried figs. If you use dried figs, the soaked fruit can become very hydrated, so

you might need to reduce the tea by 20g. Conversely, if you use fresh figs, you may need to adjust the hydration by adding an extra 20–30g. It is often a question of trial and error when using fruit in sourdough so remember to keep a loaf record and adjust your liquid accordingly the next time you bake.

- When you shape, keep the fruit inside the loaf as much as possible, as if it is on the crust it is likely burn.



Earl Grey, fig & kamut® loaf





Smoked kibbled rye & wild cherry sourdough

MAKES 2 LARGE BOULES ABOUT 1230G EACH OR 3 BATARDS OR BOULES ABOUT 820G EACH › HYDRATION 85%
LESSON **SMOKING SOURDOUGH AND USING KIBBLED FLOUR AND SPROUTED GRAINS TO ADD TEXTURE**

› INGREDIENTS

- 225g [leaven](#)
- 850g water for the dough
- 800g white flour
- 100g rye flour
- 100g wholegrain flour
- 20g fine sea salt

› INCLUSIONS

- 200g kibbled smoked rye grains
- 200g dried sour cherries, pre-soaked and drained
- 100g sprouted rye, optional

› SUGGESTED STARTER Any

› SUGGESTED METHOD Retarded

This loaf is all about flavour that matches texture. The freshly smoked, kibbled grains bring a chewy texture and impart a fruity sweetness, reminiscent of German rye breads. Paired with the rich and fruity tones from the cherrywood smoke, they take on an extra dimension resulting in a beautifully complex loaf. In late summer we dry fresh Morello cherries, which I like to soak and then mix into the dough to add an irresistible sweet-sour tang.

Of course you don't have to stick to using rye grains, there are many other possible combinations, each with their own appeal. Think spelt and apple wood, or emmer and maple. I love to sprout and smoke the naked oats that heritage grain grower John Letts sometimes drops in to me, using sweet mulberry wood cut from the tree outside the School. If you like something with a bit more smokiness to it, lightly smoke your loaf after you bake it. If you add sprouted rye then reduce bulk to 3½ hours as the rye is pretty active.

Advice

- › Occasionally we add sprouted rye for extra chewiness and texture. See [Sprouting](#).
- › See [Smoking](#).

- There are various ways to obtain fruitwood. The most obvious is to simply forage or find a tree, and to ask the owner if you can swap wood for bread. Alternatively, carpenters and local artisan woodworkers will often save you wood shavings, or consult the list of [resources](#).

- The enzymes and pentosans (sugars) in the rye provide a boost to fermentation in both the leaven and the dough by making more sugars available to the yeast, so it is a good idea to reduce the bulk fermentation for the ambient method by about 30 minutes or so.

- This loaf has a darker more caramelised crust, but do check its progress at the end of baking.

- If you smoke your loaf, do so lightly. Less is more! The gorgeous flavours that develop from smoking sourdough are all about subtle suggestions around the crust rather than a loaf that tastes like it has been in a bonfire.

- You can kibble your own grains in a pestle and mortar or mill if you struggle to find any.



Smoked kibbled rye & wild cherry sourdough

Miso & sesame

MAKES 2 LARGE 1.4KG BOULES OR 3 BOULES OR BATARDS ABOUT 980G EACH › HYDRATION 80%

LESSON INCREASING HYDRATION USING THE TANGZHONG METHOD AND LAYERING FERMENTATION

› INGREDIENTS

225g [leaven](#)

800g water for the dough

700g strong white flour

300g strong wholegrain (lightly sifted which produces a lighter loaf)

5g fine sea salt

50g miso paste



FOR THE ROUX

100g white flour

325g water

30g sesame seed oil

Mix the oil and water in a pan over a low heat. Stir continuously, adding the flour a little at a time until it forms a thick paste. Cook for a further 3–5 minutes stirring continuously. Allow to cool. Add in to the dough at the end of mixing.

› INCLUSIONS

100g lightly toasted black sesame seeds AND 100g lightly toasted white sesame seeds (for rolling the dough in)

› SUGGESTED STARTER Any

› SUGGESTED METHOD Any

Close your eyes and hold on to this moment. Taste the saltiness and depth of the miso, smell the aroma of toasted sesame, feel the crust crunch and yield of the softest sweet aromatic crumb.

Is there a formula to love? Perhaps not, but this gets pretty close. We make and ferment our own koji and miso, so it seemed natural to layer in the fermentation and use miso in our bread.

This formula includes toasted sesame seeds and fermented soybean miso, and uses techniques borrowed from the Asian Tangzhong bread method, which softens the crumb beautifully. This method involves making a roux using flour and water, which is mixed and heated to 65°C in much the same way as porridge. This gelatinises the flour and forms a translucent pudding-like paste. As the bread bakes, starch granules in the dough absorb water and swell up. The starch in the roux is already swollen to its maximum, so incorporating the roux into the dough means the starch does not have to compete with the proteins to absorb water as it bakes, and so it makes a softer, more hydrated crumb.

Advice

▸ **Use a good-quality unpasteurised miso for the best flavour.**

▸ **Keep in mind that the process of cooking the flour to make a roux denatures the gluten. The gluten in the rest of the flour in the formula is needed to provide the gluten network. The small amount of oil adds more intensity to the flavour, but also tenderises the crumb and allows lightly increased extensibility.**

▸ **The miso and salt are added together. The amount of salt is reduced, to balance the high level of salt in the miso. You may not even need any salt, depending on the levels of salt in your miso – adjust to your taste accordingly.**



Miso & sesame

Soy, ginger & rice sourdough boules

MAKES 3 X 600G LOAVES › **HYDRATION 80%** (rice consistency will impact overall hydration by 5% either way)

LESSON CONTROLLING THE FLAVOUR OF SOURDOUGH TO MAKE A SWEET, ASIAN-STYLE BREAD AND USING SOY INSTEAD OF SALT

› SCHEDULE

225g [leaven](#)

750g total water

100g soy sauce (this has roughly 20g of salt)

200g strong wholegrain flour

800g strong white flour

› INCLUSIONS

400g cooked sushi rice. Cook the rice, leave to cool and use at 26–28°C. Mix in just before the first fold.

100g chopped stem ginger, drained of its syrup

20g sesame oil

10–20g seaweed, such as dulse or nori, soaked in water for 2 hours, drained and chopped finely

40g koji rice, for rolling the dough in

› SUGGESTED STARTER White

› **SUGGESTED METHOD** Ambient or retarded, though the ambient method will make a sweeter-tasting bread.

This loaf, which is perfect with thin slices of smoked salmon, was inspired by my love of sushi. The inclusion of sushi rice adds a lovely chewy gelatinous characteristic to the dough.

I often compare flavour to a chord played on the piano: top, middle and bottom notes combined. This sourdough is harmonious, especially when made with our white, French sourdough starter. When this starter was analysed by microbiologist Marco Gobbetti at the University of Bari in Italy he and his team identified bacteria kimchi, a facultatively heterofermentative microbe, as one of the dominant strains. This particular microbe produces more lactic acid, which means that the dough ferments with a more delicate base flavour, allowing the notes of sweet ginger, sesame and soy to take centre stage, and explains why it produces a milkier, lighter-flavoured bread.

Advice

- Check the salt content of the soy sauce. Look for one with 16g salt per 100g of sauce.
- Keep an eye on the speed of fermentation, as the temperature of the water in this formula is higher than usual.
- At the School, we ferment our own koji and use it to roll the dough in just before it goes into the banneton, in the same way as you might roll the dough in seeds or malted flakes. Koji is available from specialist Japanese shops, but a handful of ordinary rice, slightly overcooked and patted dry, would have a very similar effect if you can't find it.







Soy, ginger & rice sourdough boules

Pumpkin & polenta sourdough

MAKES 2 LARGE BOULES › **HYDRATION 80%** (porridge consistency will impact overall hydration by approximately 10% either way)
LESSON USING ROASTED PUMPKIN TO MAKE A LEAVEN AND POLENTA PORRIDGE.

› INGREDIENTS

LEAVEN FOLLOW THE MASTER METHOD, USING THE INGREDIENTS BELOW

30g white French starter

300g cooked, drained, mashed pumpkin

100g strong white flour

30g water at 35°C

750g water for the dough mixed with 100g cooked pumpkin

800g strong white flour

200g sifted wholegrain flour

20g fine sea salt

› PORRIDGE INCLUSIONS TO BE FOLDED IN

400g cooked polenta

200g pumpkin seeds, soaked overnight and drained well

100g sultanas

20g mixed spice powder – to dust lightly over the water added to the dough in the last bassinage.

200g pumpkin seeds, for rolling the dough in

› **SUGGESTED STARTER White** – it is soft and allows the pumpkin to come through.

› **SUGGESTED METHOD** This is best made using the ambient method. However, if you want to use the retarded swap the white flour in the pumpkin leaven for sifted wholegrain.

Sweet, aromatic and tender, with a soft crumb and burnt orange crust, this is a loaf that can take centre stage on a chilly autumn evening, the kind that calls for a wooden table, a large bowl of steaming soup and a roaring log fire.

Once I've stopped dreaming about eating it, I have to turn to the practical side of making this bread. This is an advanced bread, because it uses a porridge and the technique to make the leaven is new. When vegetables such as sweet potato or, in this instance, pumpkin, are added to the leaven in the form of a purée you get a more controlled rise, as the natural sugars have already been consumed by the microorganisms in the leaven. This is particularly important for this loaf, because I've added sultanas for extra sweetness.

I also use the [pumpkin and cinnamon](#) sourdough powder to dust the top of the loaves when I score them, which is a great way to get contrasting flavour and colour.

Advice

- **As polenta cooks, it bubbles like a volcanic spring. Take care not to get burnt. Keep the hob heat moderate and stir constantly with a wooden spoon. The longer you cook your polenta, the firmer it becomes.**
- **The small amount of spice powder is lightly dusted over the dough just as the water is added in the final bassinage. Adding the spices in a small quantity at the last stage ensures they don't retard the fermentation or overpower the bread. It is a hint, not a hit of spice.**
- **Be sure to choose plump sultanas. Older, dried ones will take water away from the dough.**



Pumpkin & polenta sourdough

Honeyed porridge loaves

MAKES 2 LARGE BOULES ▸ **HYDRATION 88%** (porridge consistency will impact overall hydration by approximately 10–15% either way)
LESSON **GELATINISATION AND HIGHER HYDRATION**

▸ INGREDIENTS

225g [leaven](#)

840g water for the dough

200g strong stoneground flour

800g strong white flour

10g non-diastatic [malt](#) powder if using a roller-milled white flour.

22g sea salt

▸ INCLUSIONS

400G PORRIDGE Cook the porridge, then set aside to cool to 28°C. Mix in by smoothing it in during the [stretch and fold](#).

320–340g water Different oats take up varying amounts of water, so some discretion is needed here.

80g oats

60g lightly toasted wheatgerm

40g honey

200g flaked barley to roll the dough in



› **SUGGESTED STARTER** Any, but rye really brings out the flavours.

› **SUGGESTED METHOD** Any

Creamy oats, toasted wheatgerm and honey are classic ingredients that belong together. This is my perfect loaf, the one I dream of, but it is one that requires a real understanding of the dough and the process. The key to the voluptuous, open, honeyed crumb in this loaf is in the higher hydration, the addition of the porridge and the timings. I could wax lyrical about how good this loaf is; it really is the most delicious, sweetest sourdough. But flavour-wise, as much as this combination is a match made in heaven, it is also about the synergy between the amazing taste and just how good [oats](#) are for us.

I wish I could claim that I discovered the way to get such a gorgeous gelatinised crumb, but I can't take the credit. This method is one that was created and shared with me by possibly one of the most instinctive and brilliant sourdough bakers in the world, Richard Hart. Whilst head baker at Tartine Bakery in California, he developed a technique of adding in the porridge during the stretch and fold, after a conversation with an old original hippie one afternoon whilst standing in the queue in a bakery in Sonoma Valley in California. The genius is in the timing of adding the porridge to the dough as it is stretched and folded, which significantly increases the gelatinisation of the crumb.

Advice

- › **A higher protein flour will give this dough structure as porridge has no gluten.**
- › **Mix well when adding the water to the flour and do full stretch and folds to develop the gluten.**
- › **Lightly toasting wheat germ brings out the flavours; 5 minutes in a warm oven (160 °C/gas mark 3) is usually enough.**
- › **Barley malt extract is a delicious alternative to the honey.**
- › **Adding a further 100g of water in 20g increments will give the loaf a more open crumb, but this is best done only if you are an experienced baker. The extra water can increase enzyme activity, so will also speed the fermentation up.**
- › **For an extra shine and sweetness on the crust, dissolve a tablespoon of honey in 30ml of warm water, pour into a spray bottle and mist the loaf 3 minutes before the end of cooking.**



Honeyed porridge loaves

Yogurt light spelt boules

MAKES 3 BOULES › HYDRATION 78% (yogurt is approximately 89% water)

LESSON **STRENGTHENING THE GLUTEN IN A LOW GLUTEN FLOUR AND USING YOGURT TO SOFTEN THE CRUMB**

› INGREDIENTS

225g [leaven](#)

800g liquid for the dough 160g full-fat yogurt mixed with 640g water

500g finely milled wholegrain spelt flour

500g finely milled white spelt flour

22g fine sea salt

› INCLUSIONS

15g fennel or caraway seeds in the bottom of the banneton.

HONEY WATER To make a honey water with which to mist the loaf add 2 tablespoons of dark honey to 30g of hot water, stir well and transfer to a spray bottle. Remove the loaf from the oven about 2 minutes before the end of baking, mist and return to the oven.

› SUGGESTED STARTER **Chocolate**

› SUGGESTED METHOD **Ambient**

This loaf is sweet, milky and light, with a sour tang and a hint of fennel in the crust.

Modern spelt is the closest we have to the earliest forms of bread wheat. In evolutionary terms, spelt is the great-niece of einkorn and the daughter of emmer, and represents a turning point: before spelt, flours from the ancient grains produced much less extensible dough. Making bread with spelt flour can be challenging. Spelt generally has lower levels of proteins that are balanced in a way that means you have to work hard to get the gluten to its optimal point. It is dough that benefits from having two or three extra stretch and folds and a good deal of mixing as you add the flour and water. Salt strengthens the gluten too, so I have used slightly more in this formula.

Advice

› The soft flavours of spelt lend themselves to honey and yogurt. The yogurt will soften the crumb. Adding honey can speed up fermentation, so you might want to reduce the bulk fermentation slightly. Do remember to keep a record of your timings and temperature and adjust your next bake accordingly.

› Many students who visit the School report that they find spelt easier to digest. It's almost impossible to say exactly why this is, but

for a discussion on this see [The health benefits of sourdough](#). A very good tip if you do suspect that you have digestive issues with undigested flour is to use [sourdough](#) powder to dust, or potato flour for the bannetons as using ordinary flour means that there will be remnants of undigested flour on the outside of the loaf after it has been baked.



Yogurt light spelt boules

Kefir milk sourdough loaf

MAKES 2 LOAVES › HYDRATION 75% › LESSON USING KEFIR TO MAKE A SOFT CRUMB SOURDOUGH

› INGREDIENTS

750g fresh kefir milk for the dough fermented for no longer than 12 hours overnight OR buy some from a store

20g melted butter

650g strong white flour

350g wholegrain flour

20g fine sea salt

225g [leaven](#)

› INCLUSIONS

1 teaspoon fresh nutmeg freshly grated, to dust the banneton

› **SUGGESTED STARTER AT THE SCHOOL, WE USE THE WHITE FRENCH HOMOFERMENTATIVE SOURDOUGH STARTER, AS IT FURTHER ENHANCES THE PRODUCTION OF LACTIC ACID, KEEPING THE LIGHT MILKY TONE OF THIS BREAD.**

› SUGGESTED METHOD ANY

Using a milk product in sourdough is one of the easiest ways to soften the crust and the crumb. We serve milk kefir in the mornings at the School and I often get asked whether it can be used on it's own to make sourdough, but to be honest I don't recommend it. On occasion, I have made superbly fermented sourdough using just kefir milk, but getting the kefir to be at its peak can be challenging, especially for those new to fermenting. The yeasts in milk kefir can also be less active than those in a starter, so although the loaf's crumb may be full of flavour it may not have much rise.

So this version uses both kefir milk and starter to get the best possible rise and flavour, as well as a small amount of butter, which really accentuates the flavour.

As it bakes, this rich, buttery loaf produces aromas reminiscent of bread pudding.

Advice

- › I use a teaspoon of freshly grated nutmeg in the flour as I shape – perhaps because the smell of baked milk reminds me of rice pudding – just for the flavour in the crust rather than a full-on taste in the loaf.

- › The leaven (which is effectively a microbial war zone for food) has lots of competing microbes, so can become over acidic quite quickly. A good tip is to make sure that you use the leaven as soon as it is ready.

- For bakers who want a soft crust wrap your bread in a clean cotton tea towel whilst still warm, for about an hour, and then remove. This moistens the crust.



Kefir milk sourdough loaf

Malted muesli boule

MAKES 2 LARGE BOULES ▸ **HYDRATION 75%** (muesli soaker will impact hydration by approximately 10% either way)
LESSON **LEARNING TO ADAPT TIMINGS TO A FASTER FERMENTING LOAF AND ADDING PORRIDGE**

▸ **INGREDIENTS**

225g [leaven](#)

750g water for the dough

500g malted flour

500g strong white flour

20g sea salt

▸ **INCLUSIONS**

First cook the muesli in the same way as you would porridge and allow to cool

120g dried muesli porridge

200–250g water You may need to adjust the water to muesli ratio as different brands will take varying amounts water.

200g malted barley flakes to roll the loaves in

▸ **SUGGESTED STARTER** Any, though rye will give a great base flavour.

▸ **SUGGESTED METHOD** Retarded for maximum digestibility.

This loaf has a voluptuous, chewy, creamy crumb, and the malt brings both amazing sweetness and a rich, deep burnished colour to the crust. The flavours remind me of a bowl of warm porridge served with cream and whisky I was once treated to in Scotland.

The muesli creates the creamy texture and complements the flavours and textures of the flaked malted oats, wheat and seeds, as well as the malt in the flour. It's a great loaf to enjoy at breakfast with marmalade. The benefit of this formula is that the diversity of grains provides a diverse range of food for your gut microbes and so can help contribute to your [gut health](#).

We make our own muesli, but if you are buying your mix look for one that's organic with no added sugar and packed with nuts, seeds and malted flakes. Some varieties of muesli will need more water than others to make the right consistency porridge, so the amount of water advised is

approximate.

Advice

- As this dough contains both malt and porridge it can be challenging for beginners. Running your hands under very cold water and drying them before you shape can make handling the dough more manageable.
- The important thing to understand here is that the simple sugars made available to the microbes accelerate the rate of fermentation, so you will need to shorten the timings to accommodate this or you will end up with a sticky mess, especially if the weather is warm. I can't give exact timings for shortening the process, as this depends on the ambient temperature of your kitchen, but, as a rough guide, at the School we cut about an hour off the autolyse when using the ambient method and about 30 minutes off the bulk fermentation when using the retarded method.



Malted muesli boule

Einkorn & spent ale grain sourdough

MAKES 2 LARGE BOULES OR 3 BATARDS › HYDRATION 83% › LESSON BLENDING HERITAGE FLOUR AND CREATING TEXTURE USING GRAINS AND CONNECTING TO OTHER ARTISAN MAKERS

› INGREDIENTS

225g [leaven](#)

835g water for the dough

700g strong white flour

300g einkorn wholegrain flour

20g fine sea salt

› INCLUSIONS

200g sultanas

200g spent beer malted grains (see [advice](#))

› SUGGESTED STARTER Any

› SUGGESTED METHOD Any

This is a loaf that celebrates the origins of bread. Beer and bread have been bound together for so long that the origins of their connection are forgotten, but we know from inscriptions on the walls of Egyptian tombs that they were fermented side by side thousand of years ago and although it is rare that they meet as ingredients, they nevertheless belong together.

This technique uses 30% einkorn, a rich dark, nutty, aromatic heritage grain that is the first grain known to be cultivated. It has low extensibility, so in order to get a good boule shape and take advantage of its gorgeous flavour we blend it with a modern variety. Perhaps as an extension to this history we decided to use this as part of the blend of flour that we make our spent grain bread with.

When I teach, I often talk about connecting to your dough, and this formula is one I always encourage people to mix by hand. There is joy in both connecting with the ingredients and other artisan makers; when you mix grains, water, flour and wild yeast, you should appreciate what goes into the dough. Making a good craft beer, like making bread, is about using your senses, so take the time to find and talk to your local artisan brewer.

Advice

- I'll admit that spent grain is not an ingredient that is easily available. It involves finding someone who runs an artisan brewery and having a conversation with them to see if they might be willing to give you some spent grain in exchange for a loaf of bread. It's not your typical trip to the supermarket, or even a click online, but neither is this your typical loaf. It's about being creative and connecting to the world. It's worth getting more spent grain than you need as it freezes well.
- If you can't find a brewer, you can substitute with flaked grain, which has been soaked in beer for an hour and drained. If you use malted grain you will need to shorten the bulk fermentation using the ambient method by about 40 minutes.
- Finally, and perhaps most importantly, become familiar with how the dough feels as you mix, fold and shape. Learning to instinctively trust your senses and slow down and feel separates the good bakers from the truly amazing ones.



Einkorn & spent ale grain sourdough

Cracked black barley & stout bread

MAKES 3 MEDIUM LOAVES › HYDRATION 80% (porridge will impact hydration by 10% either way)

LESSON ADDING TEXTURE WITH KIBBLED (CRACKED) GRAIN AND FLAVOUR USING STOUT AND BARLEY POPCORN

› INGREDIENTS

225g [leaven](#)

800g water

200g strong wholegrain flour

800g strong white flour

20g roasted barley [malt](#) powder

20g sea salt

› INCLUSIONS

PORRIDGE MADE WITH CRACKED BLACK BARLEY

100g barley

350g stout

100g barley popcorn

Cook the porridge slowly, adding in the stout a bit at a time. It should be thick enough to coat the back of a spoon, and not too runny. If it cooks too quickly you will need to add more water to compensate for evaporation, so add 20ml of water at a time and keep cooking until it is gelatinous. To make the barley popcorn, soak the whole barley overnight in water, drain well and dry, then toast lightly until it pops. Add the popcorn to the cooked porridge, then set aside to cool and use at 28°C. Fold in on the last fold for a marbled effect.

200g flaked wheat to roll the dough in

› **SUGGESTED STARTER** Any, however rye will give a great base flavour to this loaf.

› **SUGGESTED METHOD** Retarded for maximum digestibility.

This is a fantastically chewy, richly textured loaf, with a complex aroma that is almost like licorice. Black barley is a small, gorgeously glossy dark grain. It is used in beer production to make malt, as it has coffee and chocolate flavours that are reminiscent of stout. Using stout as the liquid therefore echoes the flavour of the barley.

I'm the first to admit that this is not a beginner's loaf. It's a challenge, but it's fun to play and once you get into the routine of making sourdough you will want to experiment with new textures and flavours. When we first tried using black barley we began by milling it into the flour and also tried using sprouted grains. In the end, we settled on milling the barley on an open setting on one of our small flour mills to make cracked black barley, and then used this to make 'porridge' with the beer. If you don't have a mill, grinding the grains using a pestle and mortar is almost as effective. Making the barley into porridge is what made a real difference to the texture and flavour of the bread. For an additional burst of flavour, we also toast some of the barley to add a sweet popcorn taste to the porridge – the grains split, then pop when you toast them, and they smell amazing.

Black barley is, for the most part, unchanged from when it was first cultivated (unlike pearl barley, which has been hulled, steamed and polished) and so is sometimes referred to as a heritage grain.

Advice

▸ **Black barley isn't always easy to get hold of, but specialist beer suppliers sometimes stock it. We simply googled it and bought it online. If you can't find any, some supermarkets now sell ready-cooked black and pearl barley, which is a great substitute – simply use this instead of making a porridge and substitute water for stout for a very similar loaf.**

▸ **The higher alcohol levels in the stout will negatively affect the fermentation, so using the beer to make the porridge removes the alcohol and helps to hydrate the barley. Barley can be a very thirsty grain, and the amount of stout needed can vary – the porridge should be the same thickness as the consistency you make for breakfast.**



Cracked black barley & stout bread

Sourdough baguettes hybrid & 100% sourdough

MAKES 4 X 30CM BAGUETTES ABOUT 500G EACH › HYDRATION 77% (HYBRID 79% HYDRATION)

LESSON BAGUETTES, HYBRID SOURDOUGH AND UNDERSTANDING THE KEY TO DIGESTIBILITY

› **INGREDIENTS**

For the 100% sourdough version

225g [leaven](#)

For the hybrid

225g leaven

5g organic fresh yeast mixed with 20g water

770g water for the dough

900g strong white flour

100g strong wholegrain flour

10g non-diastatic [malt](#) powder

20g toasted wheatgerm (optional)

20g fine sea salt

› **SUGGESTED STARTER White (homofermentative) for a sweeter, lighter traditional French flavour**

› **SUGGESTED METHOD Retarded**

Baguettes might seem simple but in fact they are one of the most challenging sourdoughs to make, requiring both practice and a degree of skill. That said, once you have mastered making them, they are so good you will probably never buy a commercially produced baguette ever again.

A good baguette is an integral part of French culture. The ones I grew up eating in southwest France were made in the traditional way with only a tiny amount of yeast (about 1%) combined with a sourdough starter that was kept very [lactic](#), which produced a light, open crumb, a very gentle tang and a wonderfully chewy crust. The long slow fermentation associated with sourdough is one of the reasons that French baguettes always taste so amazing.

When planning the breads to be included this book, I was in two minds about this technique of combining commercially produced yeast with sourdough. Some sourdough purists will be throwing their hands up in horror, but I felt it was important for people to understand that yeast can, when used in combination with a sourdough starter, produce a slightly different flavour and potentially a more open crumb. Also that it is not the yeast itself that is the key to the magic, but the symbiotic relationship with the lactic acid bacteria, which alters the pH of the bread. It is this dual fermentation, and the production of organic acids by the lactic acid bacteria, that is the key to the changes in flavour and digestibility of the bread. So, if you are a purist and want to do this without yeast, simply follow the master method. If you want to try the combined method, please use organic yeast, which has far more synergy with our ethics at the School.

Advice

- › In France, baguettes are usually about 50cm long, but for a domestic baker the best advice I can give is to measure both your oven and your baking stone and to use these as your guide.
- › Steam is essential to get a good spring in the oven. At the School we use a spray bottle to add a fine mist as the breads go into the oven. Another way to add steam is to pop a large tray into the bottom of the oven and allow it to preheat. As the loaves go into the oven, pour a large cup of water into the bottom of the tray, which creates plenty of steam.
- › For either method extend the Autolyse WITHOUT leaven or yeast for 2–4 hours. This allows for maximum gluten development.
- › For the hybrid version, reduce the dough temperature to 23–24°C.
- › The retarded method needs just 30 minutes bulk fermentation with only one stretch and fold. It is then shaped AFTER the overnight ferment in the fridge. So cover the bowl with a damp cloth, pop it in the fridge and shape the following morning. Effectively this means that the dough has a longer final prove at ambient temperature once it has been shaped.
- › One of the reasons this is a demanding bread to bake is because the skill lies as much in the timing of the fermentation as in the handling of the dough, so shape gently, but firmly. This takes practice and you will get better at it over time.
- › Bake time is reduced to 20 minutes.
- › Whenever possible we use French T65 flour for the baguettes, but if you can't get it a fine ground white bread flour or a lightly sifted stoneground wholegrain flour will work. You might need to shop around and compare the texture of a few flours.
- › The wheatgerm is optional and has been added mainly to intensify the aromatic toasted flavour.

Advice for the hybrid version

- › The timings for the hybrid version are slightly shorter because the commercial yeast proves the dough faster.
- › For the ambient method reduce the time of the bulk fermentation to 2 hours.
- › For the retarded method just 30 minutes bulk fermentation should be enough, then refrigerate overnight in a cooler part of the fridge at 5°C and give a final prove of just 1½ hours.



Sourdough baguettes hybrid & 100% sourdough



BAGUETTE SHAPING

There are as many shaping techniques for baguettes as there are days in the week, and different hands like different techniques, so it's worth watching our online video.

If, like me, you get overwhelmed with trying to get the perfect baguette (I nicknamed this challenge 'baguetettegate'), relax and remember that the purpose is to create tension whilst maintaining the air – a bit like putting a seal on the tyre of an old-fashioned bike – to ensure the baguettes hold their shape and are firm enough to score.

Baguettes are easier to shape when the dough is ever so slightly underproved.

Begin by turning out the dough onto the table and dividing into four 500g pieces. Use plenty of flour on your hands, but not too much on the work surface.

Take the first piece and fold one edge into the centre of the dough, then fold the other side to join in the middle. Press down along the join with your fingers to create a seal. Be gentle but firm and try not to knock the air out.

Using your thumb, roll the dough over itself to create tension, but take care not to deflate the dough. Stretching it in this way will create tension that ensures stability.

Roll the dough back towards you, then roll away from your body with pressure on each side to taper the ends.

After this first roll, stop and let the dough relax. Leave it for a minute or two before shaping again.



Time & sequence guide for 100% sourdough baguettes

Time & sequence guide for 100% sourdough baguettes

These are the timings for the 100% sourdough we make at the School. Please read them through before you begin baking. To accommodate your flour and ambient temperatures you may need to adjust these timings.

STEP	AMBIENT	RETARDED
REFRESH STARTER For a white starter or chocolate starter	Day 1: 11am But if you are going to work then 8am would be ok	Day 1: 11pm Leave out on the side overnight
OR for a wholegrain or rye starter	Day 1: 5pm	Day 1: 6pm Leave out on the side until 10pm then refrigerate overnight
MAKE LEAVEN	Day 1: 11pm	Day 2: 8am
MIX & AUTOLYSE without leaven	Day 2: 6am	Day 2: 8am
CONTINUE WITH AUTOLYSE & MIX IN LEAVEN	Day 2: 8.30am	Day 2: 12.30pm
ADD EXTRA WATER & SALT	Day 2: 11am	Day 2: 1–1.15 pm
BULK & STRETCH & FOLD	Day 2: Until 1pm	Day 2: 3pm once the bulk fermentation has finished you need to cover the dough with a damp cloth and leave overnight in the fridge
SHAPE	Day 2: 1–2pm	Day 3: 8am
FLOOR TIME		
FINAL PROVE	Day 2: 2–4pm You can put it in the fridge for half an hour to firm up	If your fridge is 5°C or below, leave the dough for another hour on final prove
BAKE	Day 2: 4.30–6pm	Day 3: 10–10.30am





Digestibility & nutrition

The madness of modern bread

The more I researched into the history of bread the more obvious it became that my digestion problems were part of a much wider picture. Not only is sourdough easier to digest, it is more filling, nutritious and delicious than industrially produced bread – but why?

Bread has been part of our history since Neolithic times. Its development covers every aspect of life, from when survival depended on the harvests all the way to recent industrial advances. Today, there has never been a more exciting time to bake, as the revival of ancient milling techniques, modern microbiology and sourdough fermentation collide, allowing us both to understand and bake the most delicious and nutritious bread possible: sourdough.

Records show that until the Industrial Revolution almost all bread was fermented long and slow using wild yeast, lactic acid bacteria and stoneground flour. Then, almost overnight, everything changed as technological advances in the agricultural, manufacturing and baking industries happened simultaneously.

In the early twentieth century millers altered their process from stoneground to roller-milled; industrialised yeast manufacturers abandoned lactic acid bacteria; and botanists got busy narrowing the genetic diversity of wheat. Modern breadmaking uses fast-acting yeast and rolled milled flour. The entire process takes about 1½ hours. Without lactic acid bacteria none of the component parts of the flour are broken down. The magic is in the fermentation, and the acids that are produced are key to predigesting the break, making it more nutritious, nourishing and easier on people with digestive malaise.

The processed bread on our supermarket shelves is completely dependent on petrochemical-derived, synthetically fertilised and adulterated wheat, routinely treated using carcinogenic, chemically produced herbicides. The wheat used to make the bread is stripped of its nutritional properties; it is fast-processed using a single monoculture yeast strain; the bread is packed with preservatives, emulsifiers and enzymes before being packaged in wasteful plastic bags and transported long distances. It is bread that is destroying our health and our planet.



The health benefits of sourdough

It's a complicated picture so the best place to start is with an overview of reactions to wheat.

(IgE) An allergic reaction to wheat involves IgE (immunoglobulin) antibodies reacting to wheat proteins. It results in the production of histamine and is a fairly fast reaction by the body, sometimes causing swelling, wheezing, asthma, including wheat dependent exercise-induced asthma, and contact urticaria, which is an immediate, localised but transient swelling and redness on the skin after direct contact with wheat or flour. It represents 11–25% of diagnosed food allergies.

AUTOIMMUNOGENIC (IgA/IgG) These are generally slower reactions and include auto-immune diseases such as coeliac disease, which affects 1% of the population and is triggered by gliadin, one of the proteins that makes up gluten. Other reactions include dermatitis herpetiformis (similar to eczema) and gluten ataxia, with symptoms such as abdominal pain, double vision, constipation and diarrhoea.

NON-COELIAC GLUTEN SENSITIVITY Estimated to affect about 6% of the population, this is where eating gluten leads to symptoms that improve once it is removed from the diet. These symptoms include headaches, joint and muscle pain, a foggy mind, nausea, abdominal pain, diarrhoea and constipation. Unlike wheat allergy and coeliac disease, gluten sensitivity does not have a recognised set of symptoms. Doctors cannot tell if someone is suffering from it by examination (although there is a blood test, it doesn't give accurate results for many patients). So this sensitivity can only be diagnosed by ruling out other diseases and then trying a gluten-free diet.

There is another factor to consider here too, which is that although gliadin might be the trigger for coeliac disease and be the protein at the heart of many reactions to wheat, it is not the only protein in grain that can cause sensitivities; it could be albumin, globulin, gliadin, glutenin or gluten and, just to make things even more confusing, there are also many sensitivities to wheat that are neither non-allergic nor non-autoimmune. One of the most common of these is irritable bowel syndrome and there are reports of up to 20% of the population suffering from IBS.

Many people with issues digesting fast-fermented bread report that they have a problem with gluten, but often they are self-diagnosing and wrongly blaming gluten. In many cases people suffering from IBS may be sensitive to fibre, fermentable oligosaccharides, disaccharides, monosaccharides and polyols (FODMAPS) and phytic acid. There is more on how long, slow fermentation helps to stop IBS symptoms later in

this chapter.

Sourdough is not gluten-free – that is a term covered by legislation. In the UK, only foods that contain 20 parts per million (ppm) or less can be labelled gluten-free. However, in a study on gluten degradation headed up by renowned sourdough microbiologist Marco Gobbetti at the University of Bari in Italy, the residual concentration of gluten in 48-hour fermented sourdough was 12ppm and albumins, globulins and gliadins were completely broken down.

Professor Gobbetti's study, published in 2004, first provided me with concrete evidence that sourdough was breaking down gluten. The study indicated that long, slow fermentation modified the parts of gliadin and glutenin in wheat flour that are toxic to individuals with coeliac disease. I've subsequently had the opportunity to discuss these findings with Professor Gobbetti. He explained that people were never able to fully digest gluten without the aid of long, slow fermentation because our digestive systems are relatively fast. The very long, slow fermentation process of sourdough predigests the indigestible amino acids proline and glutamine in the gluten. Proline is resistant to breakdown by the enzymes in the bowel (also reported by coeliac specialist Alessio Fasano), so the only way we can break it down is through using lactobacillus and long, slow fermentation.

It is worth noting that this study looked at dough fermented for 48 hours – a much longer fermentation than normal. This suggests that the retarded method of making sourdough results in more digestible bread than faster methods of making sourdough. To take advantage of this, you can leave the sourdough in the fridge for 48 hours, but there will be roughly a 20% drop in the oven spring. However, this may be a price worth paying if you are after maximum gluten degradation.

I must stress that a laboratory-controlled experiment done under medical supervision does not offer people suffering from coeliac disease or wheat or gluten allergies the green light to start eating sourdough bread. For obvious reasons, anyone with allergies should discuss this with their doctor first. There is also always the potential for sourdough to have cross contamination with undigested flour.

IS GLUTEN DEGRADATION IN SOURDOUGH THE ANSWER TO DIGESTING BREAD?

For many people it is. One of the main reasons that people with wheat sensitivity report that they find sourdough easier to digest is, I believe, down to the degradation of gluten during the long, slow fermentation. That said the degradation of gluten actually depends on many factors, including the acidity of the dough, the length of fermentation, the kind of microbes in the starter, the kind of proteins and the levels of them in the flour – it really is very individual.



THE TRANSFORMATIVE POWER OF FERMENTATION.

The gut microbiome

I stopped being able to digest wheat after taking a large dose of antibiotics. One of the most frustrating aspects of this was not understanding why I couldn't eat bread. I was a baker and not being able to digest wheat literally drove me away from my career. What on earth was I meant to do if I couldn't eat what I baked?



I spoke to my GP about the symptoms: when I ate bread, I felt bloated and tired, had a foggy brain, my joints ached, my digestive system was challenged and my fingers would swell up so much I couldn't wear my rings. My doctor told me I was too heavy to be coeliac and too young to have colorectal cancer. He suggested I avoid wheat.

I also visited a private consultant at a well-respected clinic on Harley Street. She was a traditionally trained doctor who specialised in herbal medicine. It turned out that I did have some food allergies but she acknowledged that I also had multiple intolerances. She suspected I had intestinal permeability or hyperpermeability (leaky gut syndrome), explaining that my system had been severely compromised by many factors, including multiple antibiotics and steroids for asthma. She told me to avoid wheat completely, and for four years that's what I did.

It was during my conversation with this doctor that I first heard of the microbes in our digestive tract – the gut microbiome. Their job is to break down food into nutrients that our bodies can use. They also act like soldiers, providing a barrier system that protects the body from unwanted pathogens. The more diverse your microbial population, the more robust and healthier your digestion, which in turn supports your overall health.

WHY IT'S IMPORTANT TO HAVE A HEALTHY GUT

Over the past 20 years, more and more research has pointed to gut health being integral to our overall wellbeing. Gut bacteria are able to produce a variety of vitamins, to synthesise all essential and non essential amino acids, and carry out biotransformation of bile. They provide the vital biochemical pathways for the metabolism of non-digestible carbohydrates, which include large polysaccharides, such as resistant starches, cellulose, hemicellulose, pectins and gums and some oligosaccharides that escape digestion. Many intestinal bacteria produce antimicrobial compounds that compete for nutrients and for site of attachment in the gut lining, thereby preventing colonisation by pathogens. This is known as the barrier or competitive-exclusion effect. A robust healthy gut microbiome is vital to a healthy digestive system and because the intestinal lining is the initial defence for our immune system.

The epithelial or outer layer of intestinal cells is connected by structures that firmly adhere adjacent epithelial cells to one another, forming a seal that prevents macronutrients, such as proteins, and other ions, escaping into our bloodstream without a screening process. If your gut microbiome becomes compromised, your intestinal lining can become porous or permeable and there is a risk that your body treats the unexpected entry of such molecules as 'invaders' and triggers your immune system to set off a response. Inflammation is a natural immune response and causes even more stress to your system. As a result, each time you eat a food that contains the macronutrient that your body has registered as a threat (such as the proteins found in grains), it turns its attention to battle. Often the foods that you eat most (such as wheat) become the trigger for your immune response. It is exhausting and over time can lead to your body fighting itself and to an array of autoimmune diseases, including IBS, coeliac disease, Crohn's and diabetes.

These microbes are with us almost from the moment we are born to the moment we die, but to understand more I went to leading health specialist and author of *The Diet Myth* Professor Tim Spector. Tim has a specific interest in gut microbes, triggered by the realisation that genetically identical twins in some of his clinical studies had different health issues and very different gut microbes. He explained that intestinal permeability or hyperpermeability is a small part of a complicated picture. What is perhaps more relevant is that the diversity of microbes in those eating a Western diet is typically 30% lower than it was 50 years ago, which might also play a contributing factor in the obesity epidemic. Scientists are only just beginning to fully understand the role and complexity of the microbiome, as they are still identifying which bacteria are beneficial and how to boost them. Tim is optimistic: 'It's hoped that in future we may be able to manipulate gut bacteria to overcome illnesses, such as irritable bowel syndrome and even obesity.' The best way to support the gut microbiome, he explained, is through including in the diet plenty of fibre, [phenolic compounds](#) and the widest variety of grains and fruits and vegetables possible.

WHY SOURDOUGH IS GOOD FOR GUT HEALTH

One of the key things I learned as I read study after study is that slow-fermented bread was the missing piece of the puzzle. The fermentation facilitates a remarkable change in the flour, which in turn transforms the bread, resulting not just in increased nutrients and nourishment for us but for our microbes too. The creation of an abundance of the specific kinds of fibre, food and nutrients means that sourdough is a prebiotic. Prebiotics feed your friendly bacteria and help them proliferate on their own, nourishing and supporting the microbes that are absolutely key to our health – the same kind of microbes found in the soil and in our starters. To me, this is proof absolute that sourdough is the link that connects us. It is microbial magic.

Fibre

Sourdough can increase your dietary fibre intake by a whopping 10–15% compared to yeasted bread. The ratio of soluble to insoluble fibre can also be manipulated depending on how long you ferment your dough. Soluble fibre helps to slow the emptying process in our stomachs, which makes us feel fuller. It also helps to lower cholesterol and stabilise blood glucose levels. Insoluble fibre absorbs water to help to soften the contents of our bowels and support regular bowel movements – it also helps to keep us full and keep the bowel healthy.

Sourdough can increase your dietary fibre intake by a whopping 10–15% compared to yeasted bread. There are two main groups of fibre, soluble and insoluble. Soluble fibre helps to slow the emptying process in our stomachs, which makes us feel fuller. It also helps to lower cholesterol and stabilise blood glucose levels. Insoluble fibre absorbs water to help to soften the contents of our bowels and support regular bowel movements – it also helps to keep us full and keep the bowel healthy. The ratio of soluble to insoluble fibre in your bread can be manipulated depending on how long you ferment your dough.

Figures from the National Diet and Nutrition Survey reveal that 70% of people in the UK fail to eat the recommended daily intake of fruit and vegetables, so bread takes on an even more important role as a potential source of fibre. Beneficial microbes feast on fermentable fibres found in whole grains. They resist digestion by our enzymes as they pass through the digestive tract. These fibres arrive in the large intestine relatively intact, where our microbes can extract the fibre's extra energy, nutrients, vitamins and other compounds. Short-chain fatty acids obtained from fibre are of particular interest, as they have been linked to decreased inflammation, improved immune function and protection against obesity.

The changes in the way we grow, mill and ferment bread go some way towards explaining why the modern diet is exceedingly fibre-poor by historical standards.

Studies have shown that slow-fermented sourdough has 20–30% higher levels of a fibre called resistant starch compared to breads baked using just yeast. Resistant starch passes through the digestive tract unchanged – in other words, it is resistant to digestion and functions in much the same way as soluble fibre.

There has been a great deal of research into resistant starch but one of the most significant health benefits is that it provides food for the friendly bacteria in the gut. As this is broken down by our gut microbes they release short-chain fatty acids, which have also been shown to have a positive influence on gastrointestinal permeability. One of these short-chain fatty acids is called butyrate, which is an ideal fuel for the cells that line the colon. So resistant starch feeds both the friendly bacteria and, indirectly, the cells in the colon by increasing the amount of butyrate. The short-chain fatty acids that are not used up by the cells in the colon travel to the bloodstream, liver and to the rest of the body, where they may have various other beneficial effects with research indicating they could well provide protection against diabetes and may reduce the risk of developing gastrointestinal disorders, cancer and cardiovascular disease.

People often comment about how full they feel after just one slice of sourdough, and there have certainly been some interesting studies on how resistant starch creates a feeling of satiety and can help contribute to weight loss, by increasing feelings of fullness and reducing appetite. This increase in resistant starch helps explain one of the mechanisms by which the long slow fermented bread eaten in the diabetes studies conducted by Professor Terry Graham slowed down blood sugar response. There are also some studies which have shown that resistant starch also reduces the pH level, which in turn has beneficial effects on the colon, including reducing inflammation and lowering the risk of colorectal cancer (the fourth most common cause of cancer death worldwide). There are no human controlled trials yet, but I think it is fair to say that resistant starch could be considered therapeutic for various digestive disorders, including inflammatory bowel diseases such as Crohn's, constipation, diverticulitis, ulcerative colitis and diarrhoea.

As a last word on fibre, the longer the fermentation the higher the levels of organic acids present in the dough. So for anyone who is looking to slow down the rate at which the bread is assimilated I recommend choosing the retarded method, especially in light of the study conducted by Liljeberg et al in 1996 that demonstrated significantly increased levels of resistant starch in breads with higher levels of lactic acid.



70% OF US FAIL TO GET THE RECOMMENDED DAILY INTAKE OF FRUIT AND VEGETABLES, SO BREAD TAKES ON AN EVEN MORE IMPORTANT ROLE AS A POTENTIAL SOURCE OF FIBRE

Nutrients, phytonutrients & phenolic compounds

When it comes to bread, using wholegrain flour gives us a health advantage because it contains many natural anti-carcinogens. A number of studies show that fibre and certain vitamins, the mineral selenium and phenolic compounds found in whole grains reduce potential cancer-causing chemicals in the body.

What is really significant when it comes to sourdough is that initial studies indicate that fermenting wheat increases the level and bio-accessibility of the phenolic compounds and vitamins found in wheat. Levels of folates and phenolic compounds are almost doubled by the sourdough fermentation process, indicating that sourdough may offer more protection against a range of diseases than yeasted bread.

It is important to understand that the most abundant phenolic compounds found in wheat are the phenolic acids and flavonoids located in the outer layer of the grain. For this reason every loaf we bake at the School contains some wholegrain stoneground flour. These nutritional properties can only be fully exploited by using wholegrain flour; preferably fresh and stoneground. In recent years our knowledge of the additional biologically active compounds in the grain has increased significantly. And it is these compounds that are thought to be among the main factors contributing to the protective properties of wholegrain foods. Although the outer layers of grains contain much higher levels of phytochemicals, such as phenolic acids and folate (vitamin B12), not every loaf I make is 100% wholegrain, simply because not using white flour would be too limiting. Some just prefer lighter loaves, whilst others with digestive malaise I suggest should initially avoid very fibre rich bread to begin with.

It is the increased levels of acidity that is the key to increased availability of these remarkable compounds. It makes more sense when you realise that most of the phenolic compounds in bran are bound to carbohydrates, and can survive gastrointestinal digestion, reaching the colon intact. It is here in the large intestine that they provide an antioxidant environment.

Long, slow fermentation has also been shown to increase the folate content in the baking process of both wheat and rye flour. (Folate is a B vitamin used as a supplement by women to prevent neural tube defects from developing during pregnancy and to treat anaemia caused by folic

acid deficiency.) In particular, the levels of folates in rye fermentation more than doubled according to one study. The content of thiamine, which our bodies use to produce energy, has also been shown to increase when making slow-fermented breads, and there are studies that show retention of riboflavin – needed for growth and overall good health – and vitamin E, mainly present in wheat germ.

SO WHY IS SOURDOUGH MORE BENEFICIAL THAN YEASTED BREAD WHEN IT COMES TO MICRONUTRIENTS?

Minerals are inorganic compounds needed for your body to function properly, and they all come from the same source: the earth. Minerals make their way into plants as they grow in the soil. And we absorb the minerals from the plants that we eat.

Iron deficiency is the most widespread nutrient deficiency in the world, estimated to affect over 2 billion people. Zinc deficiency is also extensive, particularly in sub-Saharan Africa and South Asia. Wheat is a significant source of both of these minerals, contributing 44% of the daily intake of iron (15% from bread) and 25% of the daily intake of zinc (11% from bread) in the UK. Wholegrain flour is a good source of vital minerals, including calcium, potassium, magnesium, iron and zinc. Although wholegrain bread may contain high levels of these minerals, their absorption by our body may be limited due to the presence of phytic acid, the principal store of phosphorus in seeds, found in the bran part of wheat. Phytic acid binds with minerals in the digestive tract and so impairs mineral absorption. Consuming just 5–10mg of phytic acid can reduce iron absorption by 50%. Basically, you poop out all the good stuff.

Unlike cows, which have a compartment in their stomach for fermenting grass, we don't have a built-in fermentation to break down the grain. Luckily we have the ability to let our ally, lactic acid bacteria, pre-digest the grain for us, making it easier for us to absorb the minerals and fully access the nutritional richness of wholegrain flours. As sourdough ferments, the lactic acid bacteria produce lactic acid, which in turn activates various enzymes within the wholegrain flour. One of these enzymes is phytase, which breaks down phytic acid. Certain strains of lactic acid bacteria have also been shown to produce their own phytase enzymes, helping to reduce the amount of phytic acid present by up to 70% and thereby enabling a large proportion of minerals present within the wholegrain to be readily accessible and absorbed by our body.

The problem for people with compromised digestive systems is that undigested phytic acid can cause wind. People with IBS can end up feeling very bloated and uncomfortable as the gas extends already sensitive intestines. Anything that neutralises the phytic acid, such as the slow fermentation of wheat in making sourdough, will reduce bloating and gas, making bread easier to digest for most people with IBS.

There is another element here worth mentioning again – sourdough isn't just easier to digest for people with IBS. Wholegrain sourdough is also a prebiotic, providing the support and nourishment that helps nourish the often already compromised gut microbes.

Vitamins & minerals in wholegrain flour

Fermenting wholegrain flour results in a remarkable nutritional and flavour transformation making the bread not just delicious, but also increasing the bioavailability of most of the vitamin, minerals and antioxidants in flour.

Vitamins

VITAMIN E is a fat-soluble vitamin that acts as an antioxidant in the body. It is needed for the proper function of many organs and is associated with naturally slowing ageing. Its benefits include treating and preventing diseases of the heart and blood vessels as well as improving high blood pressure and blocked or hardened arteries.

VITAMIN B2 (riboflavin) is also a water-soluble vitamin, but it cannot be stored in the body, so we need a daily dose. It has strong antioxidant properties and is responsible for maintaining healthy blood cells, helping to boost energy levels, facilitating in a healthy metabolism, preventing free radical damage, contributing to growth and protecting skin and eye health. Like all B vitamins, it helps digest and extract energy from the foods we eat, which it does by converting nutrients from carbohydrates, fats, and proteins into useable energy. For this reason, B2 is needed for the functioning of every single cell within your body.

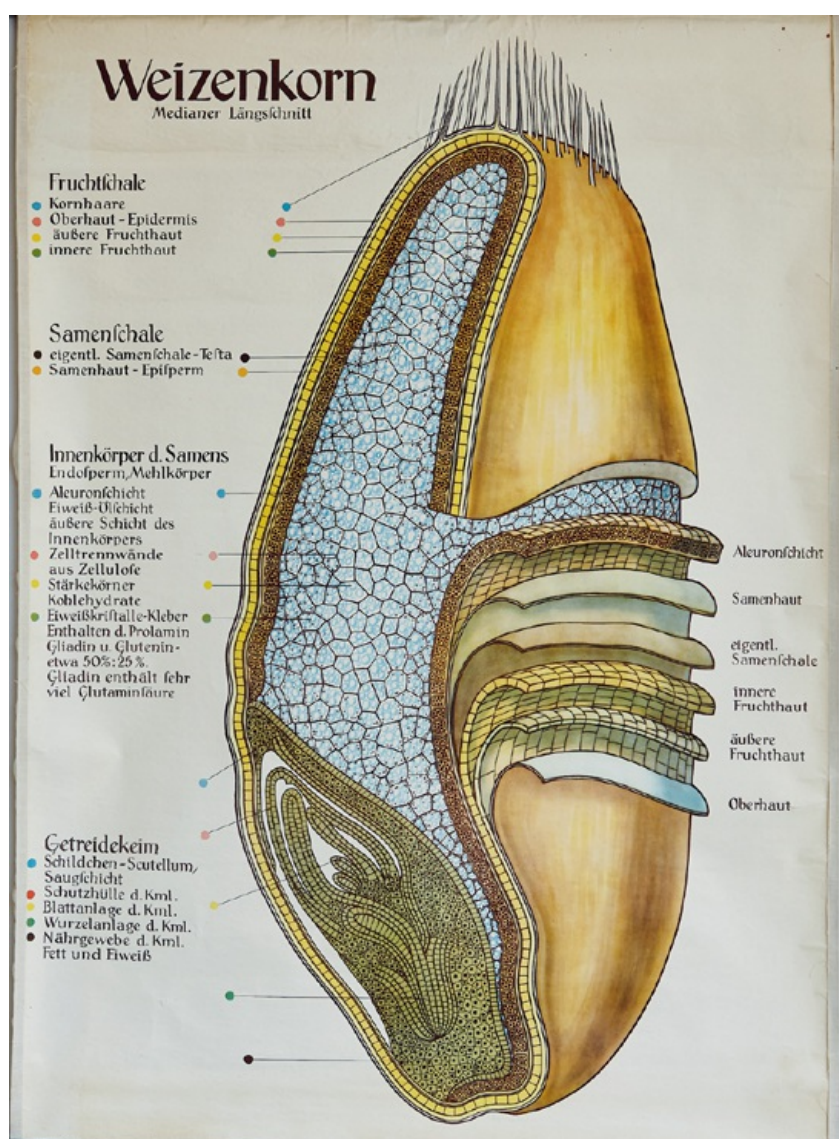
VITAMIN B3 (niacin) is another water-soluble vitamin, whose benefits include the ability to lower and control cholesterol levels. Most diabetics are able to effectively control blood glucose levels with the help of niacin, and it can also lower their risk of high blood cholesterol and heart disease, which is commonly seen in patients with diabetes.

VITAMIN B5 (pantothenic acid) has many health benefits, including the alleviation of conditions such as asthma, hair loss, allergies, stress and anxiety and respiratory disorders. Like the other B vitamins, vitamin B5 plays a role in energy metabolism. It plays a role in the synthesis of fat, hormones and carbohydrates that we take in from the foods we eat, turning them into usable energy.

VITAMIN B6 (pyridoxine) supports brain development and function. Studies show that a vitamin B6 deficiency contributes to cognitive and memory impairment, Alzheimer's and dementia. Vitamin B6 also plays an important role in making the hormones serotonin and norepinephrine, known as the 'happy hormones', which help to control mood, energy and concentration.

VITAMIN B12 benefits the central nervous system, helping to maintain the health of nerve cells, including those needed for neurotransmitter signalling. It also helps form the protective covering of nerves known as the myelin sheath. When vitamin B12 levels are low, almost every cognitive function can suffer.

VITAMIN K is another fat-soluble vitamin that plays an important role in blood clotting. It is essential for strong bones, helps prevent heart disease and is crucial for other bodily processes. Recent evidence also suggests vitamin K is an important adjunct to vitamin D.



FERMENTATION FACILITATES BIOAVAILABILITY OF VITAMINS AND MINERALS.

VITAMIN B1 (thiamine) is a water-soluble vitamin that is used in nearly every cell in the body. It plays an important role in maintaining a healthy nervous system and improving the cardiovascular functioning of the body. Without high enough levels of thiamine, the molecules found in carbohydrates and proteins cannot be properly used by the body to carry out various important functions.

VITAMIN B9 (folate) is important because it plays a role in DNA synthesis and repair and encourages cell and tissue growth. It should not be confused with folic acid, a synthetic version used for food fortification and supplements.

CHOLINE is a water-soluble macronutrient that is key for liver function and brain development, nerve function and muscle movement, supporting energy levels and maintaining a healthy metabolism.

Minerals

CALCIUM is used to build and maintain strong bones. Our heart, muscles and nerves also need calcium to function properly.

IRON is an important component of haemoglobin, essential for carrying life-giving oxygen to blood cells.

MAGNESIUM helps maintain muscle and nerve function. It keeps heart rhythm steady, supports a healthy immune system and keeps bones strong. It also helps regulate blood sugar levels, promotes normal blood pressure and is known to be involved in energy metabolism and protein synthesis.

MANGANESE benefits a healthy bone structure and bone metabolism. It also assists metabolic activity in the human body.

PHOSPHORUS is a vital part of our growth process (it is equally important to plants) and works in association with calcium to create strong bones and teeth.

POTASSIUM can provide relief from stroke, high blood pressure, heart and kidney disorders, anxiety and stress. It also maintains muscle strength and keeps the nervous system functioning normally.

SODIUM is an electrolyte that plays an essential part in fluid maintenance within the human body. It also plays a pivotal role in enzyme activity and muscle contraction.

ZINC helps the immune and digestive systems to function optimally.

SELENIUM is an essential trace mineral of fundamental importance to human health as it has positive antiviral effects, is needed for successful

male and female fertility and reproduction and also reduces the risk of cancer, autoimmune and thyroid diseases.

FODMAPs

One of the things that has become clear to me is that the symptoms of IBS can be easily confused with the symptoms of non-coeliac gluten sensitivity. The advice to sufferers who experience persistent or frequent bloating is that a special diet called the low FODMAP diet can be effective.

FODMAP stands for fermentable oligosaccharides, disaccharides, monosaccharides and polyols. These are types of carbohydrates that are not easily broken down and absorbed by the gut. In patients suffering from IBS or people who have wheat sensitivity/intolerance, the malabsorption of these sugars is related to the lack of enzymes to fully break down these complex sugars, which results in them being transported untouched into the colon where they ferment, causing gas. Worryingly, some research indicates that these sugars not only exacerbate IBS, but there are suggestions that they may possibly even cause non-coeliac wheat sensitivity.

The good news is that research has shown that the long fermentation process of sourdough bread diminishes the levels of FODMAP carbohydrates by 90%, making sourdough suitable for consumption by IBS sufferers. What I have come to believe, is that a large proportion of people self-diagnosing gluten intolerance are actually more likely to have IBS, especially when you consider that IBS is the most common functional gastrointestinal (GI) disorder and worldwide estimates of prevalence range from 10–20%. Often when people cut out wheat they are actually inadvertently cutting out FODMAPs, and yet gluten somewhat unfairly gets the blame. In recent years a multi-million pound industry has been built around misunderstanding wheat and many free-from products are packed full of additives and expensive ingredients that do very little to nourish or support the protective microbes that are integral to good health. Much of the explanation of why sourdough is more digestible for the majority of people lies in the fact that levels of fructans are drastically reduced during fermentation. Specifically, the enzymes triggered by the acids produce lactic acid bacteria, and get busy breaking down these otherwise non-degradable carbohydrates into food that has been shown to support our gut microbes. The evidence points to the fact that fermenting is not just the key to avoiding the symptoms of IBS but may well also be the key to both preventing and recovering from IBS.

Lipids & fatty acids

Wheatgerm is the small, nutrient-dense centre of a wheat kernel. It's only about 2.5% of the weight of the kernel, but is a rich source of B vitamins, proteins, dietary fibre, minerals and phenolic compounds, as well as being one of the most attractive plant-based protein sources. It also contains a range of beneficial lipids and fatty acids, the most abundant of which is linoleic acid, followed by palmitic and oleic acids. These are the 'essential' fatty acids that cannot be synthesised by our bodies and therefore need to be supplied through diet. They are associated with a range of nutritional and health benefits, such as maintaining cholesterol levels, improving physical endurance and delaying the effects of ageing. Extracting maximum benefits from these unsaturated fatty acids has always been a challenge for food scientists because of the high lipid-destabilising enzymes present in wheatgerm. These enzymes oxidise the fatty acids, destroying their nutritional and health-promoting benefits. This oxidation has also been attributed to the short shelf life of products containing wheatgerm, which is why it is completely removed by the industrial process. However, the long, slow fermentation of sourdough can preserve the nutritional state of wheatgerm fatty acids, as it results in lower levels of the oxidising enzyme lipase, increasing the shelf life. It also increases phytase activity, thereby increasing the bioavailability of minerals.



STUDIES HAVE SHOWN THAT THE MAJORITY OF GLUTEN INTOLERANCE IS ACTUALLY SENSITIVITY TO FRUCTANS (NATURAL SUGARS FOUND IN WHEAT)

Bioactive peptides

The lactic acid fermentation of cereals produces bioactive peptides. These are of particular interest because of their anti-inflammatory, anti-diabetic and antioxidant properties. Bioactive peptides are the active components of a protein, which, when they are separated from the protein, act as they would do if they were still attached. Bioactive peptides are rapidly absorbed into our bloodstream and, depending on their function, they then either enter the cell directly and move to their target site, or they reside on the cell itself and perform their job on and between the cells. In the dairy industry, there are some well-documented clinical studies that have shown that milk-derived bioactive peptides have health-promoting potential and they are therefore being targeted at diet-related diseases such as obesity, cardiovascular diseases and diabetes. Peptides derived from cow's, goat's, sheep's, buffalo's and camel's milk have multifunctional properties, including antimicrobial and antioxidant properties. They help regulate immunological, gastrointestinal, hormonal and neurological responses, and so play a vital role in the prevention of cancer, osteoporosis, hypertension and other disorders.

Recent laboratory studies have shown that sourdough fermentation results in the production of amounts of bioactive peptides equivalent to those found in the dairy industry. However, the sourdough industry cannot make any claims on these findings because, as yet, no clinical trials have been carried out. However, the findings do show that bioactive peptides survive the baking process and that they are readily absorbed during digestion.

As well as their potential health benefits, bioactive peptides and amino acids generated by sourdough fermentation help improve bread quality, taste, flavour and texture. In fact, bioactive peptides are precursors to aroma and flavour compounds, so you can literally taste the goodness in sourdough.

Lower glycaemic index & diabetes

I had been teaching sourdough for a year or so when I began to see a pattern emerging. About one in ten enquiries to the school were from diabetics asking how sourdough fermentation might help to regulate blood sugar. I found a study about fibre-rich sourdough actively retarding starch digestibility leading to low glycaemic responses by Terry Graham, professor in human health and nutritional sciences at the University of Guelph, Ontario. Professor Graham and his team of researchers had studied four types of breads to determine which had the most positive health benefits in terms of carbohydrate metabolism, blood sugar and insulin levels. The research, which took place in two studies over seven years, focused on carbohydrate metabolism in humans. He chose bread as a high carbohydrate food to use in his trials. 'I rapidly found out that bread is an extremely complex food, and its properties change not only with ingredients but how it's made, how it's baked, how it's served,' Terry explained. The results of the studies showed that the type of grains used, the way they were milled and how the bread was made all affected the properties of a loaf – pointing towards stoneground flour as the most positive. More importantly, the team discovered that the long fermentation of sourdough resulted in a loaf that was digested more slowly and caused less of a spike in blood sugar levels.

The team then looked at other hormonal responses and included other breads in their trials. The results consistently showed sourdough to be associated with more moderate blood sugar response. This is because fermentation alters the way in which starch is digested and assimilated into the body, which means that it acts more slowly, resulting in less pronounced responses in terms of blood glucose and insulin. All of which have positive implications for people trying to control their blood sugar levels.

SO HOW DOES SOURDOUGH CHANGE THE WAY THE BODY ASSIMILATES STARCH?

Firstly, it is through the use of whole grains that contain the starchy endosperm, germ and bran of the grain. The beneficial health effects of whole grains include the amount and type of fibre present and the presence of bioactive compounds, which are concentrated in the bran layers of the grain.

It is known that fibre slows down postprandial glucose and insulin responses (the mild decrease in blood sugar after eating a big meal) by having a bulking effect and presumably taking longer to digest, minimising blood glucose spikes. But, compared to normal fast-fermented breads, sourdough also contains more resistant starch.

Sourdough bread made with wholegrain, roller-milled flour was found to show a similar response to white flour, while a [sprouted grain sourdough](#) showed the most positive response. Lower insulin levels may also contribute to the protective effects of whole grains. In many people, the risk of atherosclerotic cardiovascular disease, diabetes and obesity is linked to insulin resistance. Again, higher intakes of whole grains are associated with increased sensitivity to insulin. Why? Because whole grains improve insulin sensitivity by lowering the glycaemic index of the diet while increasing its content of fibre, magnesium and vitamin E.

Breadmaking equipment

There is a huge array of equipment available in shops and on the internet. Some will help you to get consistently good results in your breadmaking, while others are nice to have and will make your baking experience more pleasurable. I like to use vintage or hand-crafted items, as I love the feel of a hand-carved wooden spoon, or the way a hand-made pot feels as I mix. I use the same equipment each time I make bread. Do this and you will soon become familiar with the way dough rises in your favourite bowl and how stiff the mixture is as you bring together the flour and water in your starter.

BAKING PARCHMENT Freeform loaves can be given their final prove and then baked on parchment paper sprinkled with semolina – so much easier for moving the risen dough into the oven.

BAKING STONE A baking stone can make all the difference to the bake of your loaves. Preheated for at least half an hour, the stone retains heat and helps to produce a good crusty base.

BANNETONS These baskets give your sourdough loaf that artisan look, and help to form a nice, chewy crust by wicking moisture away while the dough proves. Cane bannetons can be used unlined, and will leave a spiral pattern on the dough, while wicker baskets need a linen liner called a couche. They come in different shapes and sizes.

BREAD BIN A bread bin with a lid is ideal for storing soft breads, keeping them fresh for longer.

BREAD BAG A cloth or paper bread bag is perfect for storing crusty bread.

CROCK POTS WITH LIDS Ideal for keeping your sourdough starter in. It's useful to have two pots: one in use and one washed out and ready to transfer the starter into when the first one needs a clean.

COUCHE If you're baking regularly, investing in a linen couche makes a lot of sense. The cloth provides support to the dough during the second prove, and wicks moisture away to help give a better shape and crust to the finished loaf.

DOUGH SCRAPER A plastic scraper is an inexpensive piece of equipment, but one that makes a huge difference to your baking experience. It makes handling sticky dough during kneading and shaping so much easier. It's also handy for cleaning up the work surface after you have prepared your dough.

DOUGH CUTTER Use a stainless-steel cutter for cleanly dividing dough into portions. Choose one with a handle that will be comfortable to use.

DUTCH OVEN/LA CLOCHE This is a covered earthenware or cast-iron baking pot for baking breads. Keep the lid on at the start of the bake to get a good rise before the crust forms.

FLOUR BIN A large storage jar or flour bin with a lid is useful for keeping flour dry and free of dirt.

FLOUR SIFTER This saves having to put a dough-covered hand into the bag of flour when dusting your work surface while kneading. I like to have two sifters or pots – one with flour in for dusting the work surface and another with semolina for sprinkling into bannetons.

KITCHEN TIMER It's all too easy to forget that your dough needs folding or a loaf in the oven should be checked. A good timer is invaluable as a prompt to get back to the kitchen.

LAME OR GRIGNETTE Essentially a razor blade with a handle, this is used to score the dough before baking, allowing you to control the rise of each loaf. Choose one with a replaceable blade, and keep it sharp at all times so it cuts rather than tears the dough.

LOAF TINS A heavy-duty, non-stick loaf tin will turn out perfect loaves every time. Having a couple of tins of different sizes adds to the variety of loaves you can bake.

MEASURING CUPS Some formulas call for cup measures, so it's good to have a set on hand.

MEASURING JUG A glass measuring jug is useful for mixing hot and cold water to get the temperature right for mixing dough.

MEASURING SPOONS These are useful for measuring salt, as well as seeds, herbs and other additions to the dough.

LARGE MIXING BOWL I have a beautiful vintage, stoneware mixing bowl. A good large bowl gives you plenty of space to make dough without ending up with flour all over the work surface and floor, so it is better to choose a bowl that's bigger than you think you'll need.

SMALL MIXING BOWL Useful for mixing levains to leave overnight for the next day's dough.

NOTEBOOK I like to keep records of everything from measurements, temperatures and timings to the results of each bake. This helps me learn, eliminate mistakes and produce even better bread next time around. A small notebook keeps all this information in one place and easy to find.

OVEN MITTS Essential for taking hot loaves from the oven, and if tins need turning part way through baking to ensure an even bake.

PEEL Use a flat tool to slide loaves into the oven smoothly and quickly, reducing the chance of bumping your nicely risen dough and keeping heat loss from the oven to a minimum.

PULLMAN TIN This is a square-sided tin used to bake loaves that are perfect for sandwich making.

SCALES An accurate set of scales is a must for consistent results. Digital scales are easy to use and usually go up in increments of 1g – ideal for weighing small amounts of yeast and salt. There are scales that allow you to weigh in baker's percentages, cutting out the need for calculations when you want to change formula proportions.

SPRAY BOTTLE Adding steam to the oven as you put a loaf in to bake allows the crust to remain soft and to expand, giving a better rise. An

easy way to get steam in a domestic oven is to spray the interior using a bottle sold for spraying plants, before quickly closing the door.

TEMPERATURE PROBE A metal spike with a thermometer on one end. Use it to check the internal temperature of your loaves to ensure a perfect bake.

THERMOMETER Temperature has a huge impact on fermentation and can be controlled in a number of ways. Ensure the water you use to make the dough is at the right temperature using a basic thermometer.

WIRE RACK A rack for cooling baked loaves is essential – it doesn't need to be anything fancy; the same one you use for cooling home baked cakes is perfect.

WOODEN SPOONS I love using hand-carved, robust heavy spoons – not only to support other artisans but because good spoons feel amazing in your hand.

TEA TOWELS A damp tea towel can be used to cover your mixing bowl during bulk proving; used clean and dry it can be sprinkled with semolina to stand in for a couche for proving loaves shaped as batons and baguettes.

Essential equipment

A LARGE BOWL

A DOUGH SCRAPER

A WHISK

A LAME

2 X 1KG LINED BANNETONS OR A 40CM LENGTH OF COUCHE (OR HEAVY DUTY COTTON TEA TOWELS)

A LA CLOCHE BAKING DOME OR A DUTCH OVEN

Resources

ONLINE

Being a sourdough baker often goes hand in hand with being part of a community. Social media is an open community, which gives us an opportunity to exchange ideas with bakers across the world. While I appreciate that some people are cautious about using social media, it really is up to you as to how much you engage – sometimes it's great just to dip in and read.

The Sourdough Club All students who attend a course at The Sourdough School become a member of our own community of bakers. Everyone else can subscribe and join this online resource. We provide videos, instructions, detailed information and support to inspire and encourage club members in their bread making. Follow us on Instagram ([@sourdoughclub](#)), and find us at The Sourdough Club on Facebook.

[www.facebook.com/groups/perfectsourdough](#) Perfect Sourdough is a Facebook group run by Teresa Greenway. A brilliant resource and a great forum for sharing, with over 40,000 members at this point.

My favourite community is on Instagram. Most of the bakers and millers listed are friends and colleagues, they are also a great resource for ideas and inspiration, and I love browsing through the beautiful photos they post.

[@alicequillet](#) Alice is a wonderful baker, determinedly showing up the French and making really great bread and coffee- co-owner of Ten Belles in Paris.

[@boncipane](#) Bonci Gabriele is a good friend who bakes brilliant pannetone and pizza.

[@campbell2664](#) A creator of baking equipment and fabulous bread.

[@ceorbread](#) Guy Frenkel is a baker from Los Angeles, posting beautiful photos of his bread.

[@danlepard](#) Dan has mentored me for almost a decade. He is amazing and is well-known for his baking and writing. Without Dan I wouldn't be teaching.

[@emsbread](#) Emmanuel Hadjiandreou is a dear friend, award-winning baker, author and Sourdough School tutor.

[@gilchesters](#) Farmers and millers in the north east of England growing organic, heritage grains.

[@illebrod](#) Norwegian baker with principles and Sourdough School tutor Martin Fjeld.

[@katesbread](#) Kate Pepper is a Californian baker who posts inspiring photos of her work.

[@maurizio](#) Maurizio Leo is a sourdough baker and writer at [theperfectloaf.com](#)

[@michaeljames77](#) Baker, author and owner of the Tivoli Road Bakery.

[@mijtightlines](#) Matthew is a really great friend, and just an amazing baker. His bread is divine and he bakes at Outerlands in San Francisco

[@mulinomarino](#) Photos from my favourite Italian mill, and long-time friends.

[@richardhartbaker](#) Based in Copenhagen, Richard is the most instinctive and brilliant baker I have ever met – one of the best in the world.

[@season_adam](#) Adam is a tutor at the School and baked all the bread in the photos of this book. He is a fantastic sourdough baker with a superb technical and practical knowledge of sourdough.

[@smallfoodbakery](#) Photos from one of the most inspiring women and bakers I know – Kimberley Bell.

[@sourdoughschool](#) Lots of photos of bread and events here at the School.

[@vanessakimbell](#) My own account, with plenty of pictures of the breads I bake.

[@white_crystals](#) I love Crystal White. An incredible baker, she is based in San Diego, California.

[@yohanferrant](#) Half French, half Spanish, meet my friend and extraordinary baker in Spain.

INGREDIENTS AND EQUIPMENT

[www.sourdough.co.uk](#) I sell much of the baking equipment that we use at the School through our website. All the flours I use are also available through the shop pages of the website.

[www.bakerybits.co.uk](#) I'm a huge fan of this website, especially as I wrote the newsletter and developed the formulas for five years. It's an amazing resource for everything related to bread making.

FLOUR

I personally know each and every miller listed below, in the UK, Italy, France and the USA. I have stood in the fields and chatted to the farmers who grow the grain they mill into the flour I make the bread with at the School. I believe this connection between farmers, bakers and producers is integral to understanding your main ingredient and key to making great bread, so I'd encourage everyone who makes sourdough to try to get to know the millers and farmers involved in growing and milling their flour. There is a full list of all UK mills available on the Sourdough School website for readers to locate their local mill.

www.mulinomarinio.it My favourite Italian mill. I've used them for more than seven years and their Organic type '00' and '0' are the main bread flours I've used throughout this book. A gorgeous family and such amazing farmers who are deeply connected to their land and community.

www.foricher.com A French mill, which produces the superb organic T65 flour. Ethical, passionate, seventh-generation millers.

www.centralmilling.com American millers, deeply passionate about flavour, the environment and their relationship with their growers. I use their organic artisan baker's craft (ABC) flour, which is milled from a carefully selected blend of organic wheat.

www.flour.co.uk Marriage's is another superb suppliers of organic bread flour. Highly recommended, especially for blending.

www.dovesfarm.co.uk Doves Farm produce fantastic rye flour and it's the one I've used in formulas throughout this book. Their bread flour is also superb.

www.gilchesters.com British-grown, organic flours, milled from heritage wheat varieties. The wholegrain flour has been used throughout this book. The organic wholegrain is fantastically flavoursome and perhaps my favourite flour – I blend it into virtually every loaf I make. Andrew and Billie are great friends and have incredible milling and flour knowledge.

www.priorsflour.co.uk My local mill. Highly recommended. Local wheat milled in my local mill by amazing miller and friend Jonathan Cook. I also highly recommend the **Lammas Fayre heritage flours** produced by archeobotanist and heritage grain pioneer John Letts who also tutors at the School. These flours are milled from ancient cereal varieties, grown using traditional methods. Again, I have used them through out the formulas and they are available to buy from Bakery Bits Ltd.

Extensive research was completed to write this book, however there is not room to list the hundreds of studies used. For those interested, all source material and references listed are linked to the original studies at sourdough.co.uk.

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