How to roast with IKAWA

A guide to start understanding your green beans and learn to roast them to your taste.



Content

- 03 FOREWORD
- 04 GREEN COFFEE
- 05 PROCESSING
- 06 HOW TO TALK ABOUT FLAVOURS
- 09 ROASTING TECHNOLOGY
- 13 CONTROLING THE ROAST VARIABLES
- 14 KEY STAGE OF ROASTING
- 18 PRINCIPLES OF ROAST COLOURS
- 20 HOW TO FIND YOUR PERFECT ROAST LEVEL



Foreword

We have really enjoyed bringing this together for you and we hope it helps to give you some guidance as you start your coffee roasting experience. Some of the content is new but a lot of it is leaning on guidance we have accumulated over the last few years in different places. It is by no means exhaustive, as you will see, and is designed as a foundational grounding in coffee roasting as it relates to the IKAWA home roaster.

The art and science of roasting coffee is a complex one. Professionals spend their entire careers perfecting it, in much the same way as a photographer or a wine sommelier would. It takes theory, sure - but most of all it takes experience and time. You now have, right there in your kitchen (and on your phone), everything you need to gain that experience. And it's up to you how far you take this.

Ultimately, we are in pursuit of the perfect cup of coffee for us and our loved ones - but the process of learning about how to roast coffee effectively can be an extremely enjoyable one (and luckily involves a lot of tasting to do properly!).

Have fun with it. And as always, if you have any feedback for us we would love to hear it.

Onwards. Bradley - GM IKAWA At Home

Green coffee

Coffee is the seed of a fruit, often referred to as 'cherries'. The fruit trees are grown at high altitudes, typically between the Tropic of Cancer and the Tropic of Capricorn.

The coffee cherries grow slowly at these high mountain altitudes (usually 1400 and 2000 metres above sea level), and can take between 8 and 11 months to ripen. Once ripe, they are picked and processed shortly afterwards.

Once harvested and processed, the coffee is set out to dry, which takes 10-20 days, stored, then prepared for export. It's at this point that it is called "green coffee" and now it's over to you.

The flavours of the coffee may be dictated by variety, processing, and terroir (such as soil, altitude, and climate).

Terroir is a word that we hear more and more in the coffee world, but it's been used in farming, wine and fine food for years. Coming from French, it can be defined as an ecosystem in a region. It is often used interchangeably with the term 'microclimate'.

However that term doesn't take in consideration all the other factors

that affect a crop's characteristics - altitude, soil type and quality, topography and farming practices.

Roasting (i.e. applying heat) has a huge impact on the coffee taste, but it cannot change the inherent flavours of the beans. A coffee that naturally has the potential to taste nutty can't be roasted to change its flavour to fruity.

It can only present the flavours of a bean or add to it in specific ways through flavours that come about in the chemical reactions that take place such as caramelisation and browning - also known as the maillard reaction. (More on that later)

We could write a whole book about green coffee, coffee growing regions and all of their nuances. Needless to say, differences in variety and region, affect the resulting flavours and may require different roast parameters for the optimum roast. For now, we would suggest keeping note of the coffee varieties and processing that you are roasting and enjoying, as well as trying to spot any commonalities between coffee's terroir (for example, altitude).





Processing

Before we move on to the roasting itself, it is worth reviewing how processing can affect the flavour of coffee quite significantly.

This is the necessary act of removing the fruit and it's protective layers from the coffee seeds and then drying the seeds to a low, stable moisture content. This can be done in several different ways and can significantly affect the flavour of a coffee.

Generally, there are 3 main categories of coffee processing:

Natural (also known as 'dry' or 'whole fruit') processed coffees leave the cherry fruit intact and on the seeds while it is dried. This is typically done on screen beds (for best air circulation on all sides) in natural sunlight. This process has a strong influence on the final flavour of the coffee and tends to be more fruit forward, lower in acidity, and creamy in texture.

Washed processed coffees involve removing the cherry fruit and the sticky, sugary layer called the mucilage from the coffee beans, by using water. Once the fruit is removed, beans are dried. As you would imagine, this results in a crisper, cleaner flavour: increased acidity/sparkle, lighter body, and arguably allows for a better flavour representation of the inherent characteristics of the beans.

Semi-Washed (also called 'pulped natural' or 'honey') processed coffees follow a hybrid approach of the above two: where the cherry fruit is removed but the mucilage is left on the beans for drying. This process will impact the flavour by taking the best parts of washed (clean cup) and natural (heavy sweetness).

Coffee and its flavours are complex to say the least. Even coffees that are of the same variety, processed the same way, can have different characteristics depending on where it is grown. We aim to learn from your experiences roasting different coffees.

We suggest that you try out similar roast recipes on coffees with similar characteristics.

How to talk about flavours

There's no right or wrong way to talk about flavours. Every individual has their own experience with taste and smell- there is no 'perfect' way to describe coffee.

While there is no 'perfect' way to describe coffee, we really like the work done by CoffeeMind. In this diagram, you will see simpler descriptors on the outside, and more complex descriptors as you move towards the centre.

When learning how to describe coffee, think of common food and drink that you have had before. If you have never experienced the sweet acidity of a strawberry, you will have a hard time picking that note out of a coffee. Also, sometimes coffee simply tastes of coffee.

A note on "body"

For the purpose of our use, we define 'body' as the texture; ranging from light to heavy.

Light texture or body feels light in the mouth, it doesn't linger, perhaps it reminds you of a green tea. Heavier body feels like it's coating the mouth.

Perhaps a heavy bodied coffee reminds you of the texture of syrup, or cream. How a coffee is roasted, can affect the resulting body.





Roasting technology

Behind it's aesthetic appeal, the IKAWA home roaster is a smart piece of engineering. Paired with the App, you have everything you need to apply heat to green coffee beans precisely, in a controlled and repeatable way.

Pressing that start button begins a process of complimenting systems that make sure the coffee is roasted in the way that you or our recommended recipes have programmed.

When you press the start button, the fan motor, the only moving component of the machine will begin rotating. The fan does many things, most importantly for now, it draws room temperature air into the roaster. This air is then moved upwards into the roasting chamber, past an electric heat source. As the air is moving past the heat source, the temperature is measured by a precise temperature sensor (this is the temperature you will see on your App, referred to as the "inlet" temperature). The air, now hot, is blown into the roasting chamber and is doing several things at once...

- It is transferring heat to the beans as it passes around and through it.

- It is moving the beans allowing evenly distributed heat transfer (also known as "airflow" - the power of which is controlled by the black line on your App).

- And finally, it is entering the roasting chamber in such a way that creates a cyclone effect - important to ensure evenness, prevent smoke build-up, and to neatly collect the chaff as it separates during the roasting process.

Throughout the roast, electronics are simultaneously receiving data from the temperature sensor and using that data to make adjustments to the heat source according to the roast recipe that has been sent to the roaster. This same process is used to ensure the airflow , the speed of rotation within the fan motor, is accurate. It continues these tiny cycles of measurement and adjustments until the roast has finished. At the end of the roast recipe, the fan kicks up a gear to allow fast cooling of the beans before being ready to 'eject'.

Heat transfer

The most important thing in roasting, is applying heat to the coffee beans. This heat is what causes chemical reactions to take place in the beans. Besides processing, variety etc., heat applied in key stages of the roast has the biggest effect on the flavour of the end result.

There are three methods of heat transfer and the IKAWA Home roaster seeks to maximise the impact of Convection heat transfer, whilst minimising the impact of the other two, Radiant and Conduction heat transfer. This is to allow the most control possible. Let's take a look at this.



Convection Heat

While there are elements of Radiant and Conduction Heat transfer in the Ikawa Home roaster, these methods of heat transfer are minimised by using aluminum and other materials that do not retain heat energy. The main method of heat transfer in the Ikawa Home roaster is Convection.

Through Convection heat transfer, the Ikawa Home roaster heats the air that is blown into the roasting chamber, heating the coffee beans. The air might need to be heated to a very high temperature or kept at a low temperature, based on the coffee being roasted.

The heat in air is much more controllable and fit for our purpose of roasting coffee precisely according to our programmed recipe.The temperature of the air is programmed and measured using a very accurate PT1000 temperature sensor.

Measuring temperature

We are measuring the temperature of the air immediately after it has passed through the heat source, using the internal PT1000 temperature sensor. We call this measurement the "inlet" temperature because it's the temperature of the air input to the beans.

In most other roasting machines, the temperature is measured in a position that better represents the actual temperature of coffee beans (often called the "bean" temperature). To do this, these machines need to use a more durable and therefore less precise (increased resistance for those who know!) temperature measurement device sometimes called a probe.

This would not suit our needs because of the importance our machine places on the temperature measurement and the role it plays in how we control each roast - requiring precision and fast-reaction.

This makes IKAWA home recipes look very different to the average roast profile you will find on google or books written by Coffee Gurus. These two different approaches to measuring the temperature - 'inlet' and 'bean'- are aimed at the same thing: to control and roast a coffee really well.

Of course, these two measurements will correspond to one another. In the same way slamming the brakes on a car would eventually lead to the car stopping, drastically decreasing the temperature of heat applied will pause the coffee from roasting further.

For the purpose of changing a roast recipe, we can use the inlet temperature to control the acceleration or deceleration of the heat input and we can use distinct (and visible) stages of a roast to understand 'how fast the coffee is travelling'. We'll come back to these stages shortly and look at how understanding of how an IKAWA home roaster is controlled, can help us to change them.

Now we know how the roasting technology works, how it transfers heat, and how it measures temperature; we can look at how to programme it through the three roast control variables.



Controlling roast variables

Temperature and Time

Changing the temperature represents the most important way we can change our roasts because heat application has, by far, the largest impact on the different roasting stages.

On the IKAWA Home App you will see this as the red line plotted across temperature and time. And we have up to six points that we can add, remove, and change, to shape our recipe.

We can change these points by as little as one degree and one second giving us an almost infinite range to work with.

Exceptions are that we cannot apply temperatures above 290c (or 554f) to maintain safety (and to be honest, because we wouldn't want to anyway!) and we cannot roast longer than 12 minutes (for similar reasons).

Airflow

This is controlled by the black line, expressed as a % between 60% -100%, and can be changed with up to three points, four if we include cooling. This line represents the speed of the fan motor (the RPM) and, as we have read, this is what is necessary to apply heat, rotate the beans, and create the cyclone system.

Airflow can dramatically change the process of transferring heat to our coffee beans but the full extent of this is beyond the scope of our introduction.

Fundamentally, the airflow needs to be moving the coffee beans freely in order to provide even heat distribution and to avoid overroasting the bottom (or underroasting the top) of the coffee. How much airflow it takes to achieve this can vary depending on how dense and fresh the green coffee is.

Density and freshness are important to bear in mind, if for example you notice your beans not moving freely enough, particularly at the early stages of a roast when the beans have not dried out yet and are heavier than they would be at the end of the roasting process.

Within reason, there's not necessarily a right or wrong way here and we recommend focusing on the temperature controls as you get started.

As you become more comfortable with roasting, experimenting with airflow as a way to change the key stages of a roast can be really interesting. A forewarning: a small adjustment to airflow/fan speed is the best way to start experimenting.

Key stages of roasting

How do we change flavourless green coffee into something so delicious?

Warning: do not attempt to try brewing green coffee. You will most certainly break your grinder!





Amazingly, to create all the chemical reactions needed, all we have to do is add heat. The art of roasting is in how and when heat is applied. With careful monitoring of 'how fast the coffee is roasting', we can learn to tease out the flavours we love in coffee and avoid those we don't.

Luckily for us, we can monitor the visibly different colour stages of the beans through the glass lid of the roaster. The colour changes gives us a really good idea of what is happening to the coffee throughout the roast.

We start with green beans entering the roasting chamber, the very beginning of the roast. The temperature of the beans at this stage is low (room temperature). It's therefore really important we inject a lot of heat so we can properly build the momentum of our roast.

You'll notice that all of our recommended roast recipes begin in this manner. That's here that our profiles differ the most from profiles you see elsewhere. This is to do with the way the temperature is measured, using the inlet temperature measured by the PT1000 sensor. We are beginning to roast green coffee - at room temperature: we need to begin with a big injection of heat so we can quickly move our raw beans to it's first key stage: drying.

Drying

As we begin to apply heat, the beans will start to 'yellow' and this is signifying that they are absorbing heat; taking the energy it will need to fuel important chemical reactions, and starting to shed moisture from it's surface even at this early stage.

How much heat is applied at this stage and for how long will affect the speed of our roast and have an effect on the Maillard reaction/ browning.

It is typically not the stage that most affects the flavour but, of course, you can make or break a roast here and it might be interesting to experiment with.

Beware the tipping point! Applying too much heat for too long this early on can lead to a roast defect called "tipping", which is where moisture is released from parts of the surface too quickly, causing 'tips' of burning that would still be visible after the roast has finished and would not be desirable in terms of flavour.

Browning (Maillard)

As the roast progresses, the beans will start to change colour to a light brown. This is a result of a complex reaction between amino acids and sugars within the coffee. The Maillard reaction can also be observed when you make toast or seer a steak

As the browning continues, the sugars start to caramelise and produce flavours that are often associated with coffee (think caramel, toffee, sugar, etc). These reactions also start to create complexity in flavour and changes to the 'body' of the coffee when it is brewed.

Again, there is no one-size-fits-all recommendation on heat application during this stage of the roast. Each coffee has its own special 'sweet spot'. Rather, it's for you to note that important chemical reactions are starting to take place and have an impact on the end result. Experimenting with altering time and temperature points during the Malliard reaction, will give you the best chance of making an impact before moving into an essential phase: development.



First crack and development

The best part of a roast! The coffee will audibly pop or crack like popcorn and puff up slightly. This is caused by a build up of steam pressure inside the bean resulting in moisture bursting through the weakest point. Now more than at any stage in the roast so far, the inside of the bean is exposed to more heat.

We must be careful to not apply too much heat at this point. You may observe that the red line on the recommended recipe declines at this point, as less heat is necessary to progress the coffee through the roasting process.

Depending on how heat has been applied before this stage, first crack will be quick and loud or slow and long. But regardless, it's from this point that we could, if we wanted, stop the roast and consume the coffee. It's also the point in the roast where the most flavour development happens.

Because of the importance in this stage, we often refer to 'development time' as a way to track how a roast continues after 1st crack (i.e. how it develops).

Shorter development times generally have a bright profile, suitable for brewing filter coffee. Longer and darker roasts tend to be less acidic with more body and are more suitable for brewing espresso.

Things are happening quickly here: even small changes in heat application and/or time can produce different flavours in the cup. How much development time and temperature to apply is down to preference and this is a great opportunity to make changes in the pursuit of finding different flavours.

A quick note on second crack: we will briefly cover roast colour shortly but for now it's important to know that if the roast continues long enough, coffee will experience a second crack. This is slightly softer sounding and it's usually when oils will begin to move from the inside of the bean to the surface.

The coffee bean becomes quite brittle at this point. Second crack is a good marker for the point at which the darker roast flavours can dominate the inherent flavour of the coffee beans. Our recommended recipes tend to show terroir through being light-medium developed. That's our own preference and there's no right or wrong answer when it comes to your own preference!

Cooling and degassing

Once our roast has finished, we want to cool the beans down as quickly as possible in order to stop the chemical reactions and any further development past where we want to stop the roast.

Degassing is the process of allowing Carbon Dioxide to escape from the roasted coffee. Roasted coffee can be set aside in a sealed container for 3-6 days before use. We have found that coffee that has been roasted by Convective heat can remain 'fresh' tasting for several weeks. How long you leave coffee to degass is a matter of preference. You may even find it preferable to wait even longer than 3-6 days before using your roasted coffee, depending on your brew method.

We are now almost ready to look at changes to an IKAWA recipe in a more practical way. Before we do that, we want to introduce you to some of the ways that 'roast colour' typically changes the flavour of your coffee.

Principles of roast colours

The colour of roasted coffee will change depending on the heat applied during the key stages of a roast. The colour to which the coffee is roasted, depends on your preferences. The colour also indicates the flavours that may be present.

On one end, you could roast 'light', risk under-developing the coffee or you could find that sweet spot to really highlight the coffee's inherent characteristics. Or you could have a more balanced approach by adding some typical 'roast' flavours, by going for a 'medium' colour. On the other end, you could achieve the 'dark' levels of 'roast' flavours, but if you push it even further, you will eventually get ashy/smoky flavours.

Let's take a quick overview of the options here and then introduce you to a useful way to think about roast 'degree' and flavours.

Light Roasts

Also referred to as "city roast", they are usually more mottled on the outside of the bea, resembling wood grain. A good light roast is sweet with lots of bright acidity or sparkle and features the inherent origin characteristics of the coffee.

You will achieve a lighter roast through less heat application and a shorter development time ,with roasts finishing shortly after first crack. 'Good' flavours are hard to achieve in 'Light' roasts: underdeveloped coffees can easily taste vegetal, sour, and weak.

Often, a higher amount of heat application at the beginning of a roast is beneficial to developing any coffee and especially lighter roasts. Lighter roasts are aiming to showcase the terroir, variety and processing of the coffee. Developed properly, lighter roasts can make for amazing cups of unique flavoured coffees.

Medium Roasts

Also called "full city", the medium roast lives between the end of first crack and the beginning of second crack.

A good medium roast will highlight the unique flavours within a coffee and have a complimentary body and sweetness. You will also start to taste some of the roast flavours in the cup (see the darker colours in our recommended flavour resource mentioned earlier).

The acidity or sparkle will be lower than a light roast. Generally, the sweet spot for a medium roast is larger than it is for a light roast; meaning you have more wiggle room to produce different, great tasting coffee and you usually have more flexibility when brewing.

Dark Roasts

Typically roasts that go past second crack. These roasts have very reduced acidity and unique flavours. The body tends to be full and the beans are very soluble when brewing. Roast flavour is dominant which can produce flavours that are smokey or ashy in flavour.

This isn't to say that all dark roasts are bad - a good dark roast of the right green coffee is enjoyable. It can be dense and sweet with enough acidity to cut through and balance the coffee. However, like a light roast, the balance is fine and a dark roast is usually easier to get wrong than right.



How to find your perfect roast level

We recommend experimenting with differing roast levels to find what you generally prefer.

As you get used to changing recipes at different stages in the roast, you will start to notice what causes a shift in this area. It's important to remember to approach any changes in a recipe empirically:

Change one point at a time and observe how that one change altered how the coffee moved through the roast cycle, i.e. how did the speed of the coffee change?

Our recommended recipes are just the beginning of your experience.

Great job for getting this far!

Now that you have the knowledge and basic principles of the Ikawa Home roaster, you are empowered to make changes to those recommended recipes, turning those recipes into your own.

We hope that this document has been helpful for you to learn more about how your Roaster works, a brief theory of Green Coffee and roasting, and the logic behind how the recipes work. It is now time to put it all to practice!

Now armed with this information, we want you to pick a recipe to make even better! When we say even better, it means to tweak the coffee more to your personal preference.

It's your turn to experiment

Use one recipe, recommended for either filter or espresso and roast green coffee without changing the recipe.

Then, move one of the points on the red line, changing the coffee to make it more towards your liking. Whether that's a darker roast or a fruitier taste, always note what you wanted to achieve and how you went about doing it.

You will now have two roasts to compare to each other. You can repeat the second step multiple times, for multiple roasts, to see how they compare to the original recipe a.

Once the tweak is done, please roast the coffee, allow 3-6 days to degas and compare.





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