SEKIO KAFE

# BASIC COURSE

# COFFEE ROASTING

# INDEX

# BASIC COFFEE ROASTING COURSE

# INTRODUCTION

## Welcome to this basic coffee roasting course by Sekio Kafe!!!

Coffee **roasting** consists of the heat treatment to which the coffee seed (green coffee) is subjected to obtain a brittle, easily ground product from which by infusion in water is obtained the coffee drink. During the roasting occurs the transformation of the sensory, chemical and physical properties of green coffee beans to roasted coffee product.

The **roasting of the coffee bean** is produced by the temperature rise, mainly, in the air flow circulating inside the drum where the grains are located, the transfer of heat or thermal energy is done through the air, although there are also other methods, thus affecting the physical-chemical transformation of the coffee bean.

Finally, before we go to the point of the course, let's get nostalgic about the **history** of coffee.

Legend has it that there was once a goat herder named **Kaldi,** who lived in **Ethiopia** in the ninth **century,** that when he went out with the flock to graze, he observed that **goats** when they ate the leaves and fruits of a peculiar shrub had a different behavior, suddenly they were energetic, jumping on all sides and with unusual hullabaloo. So, he decided to pick the fruits,

some red berries, to taste them himself, he cooked them and tasted them, but the drink was so bitter that he threw the berries to the bonfire, and then the beans were cooked and began to come out of the interior, roasted, giving off such an incredible aroma, seeing that they were burning, he threw them in water and so the first cup of coffee came. Another version of the story tells that Kaldi took the berries to a nearby monastery and that is there, where such events occurred, in either case, it happened fortuitously, like many of the history's discoveries.

Another legend also traces its origin to a **Sufi monk,** the protagonist was Ghothul **Akbar Nooruddin,** of **Yemeni** origin. Apparently, this monk was traveling in Ethiopia when he observed **birds** full of unusual vitality, observed to feed on the berries of shrubs near him, so he picked up some fruits and when he tasted them, he understood the behavior of the birds, for he himself experienced it.

Whatever the origin, coffee is a drink that allows us to experience the same sensations as goats or birds, apart from their taste, and, to be honest.

**Could we live, chat, and work without coffee?**

# CHAPTER 1.
# GREEN COFFEE

## ARABICA AND CANEPHORA COFFEE

These terms refer to the two most marketed varieties of the *Coffea* plant. One is the *Coffea arabica* and another the *Coffea canephora,* of the latter, its best known variety is the *robusta.* In this section we will see the characteristics of each one in order to know better their results in the roasting process and the cup.

**ARABICA COFFEE**

The ***arabigo*** coffee tree ***(Coffea arabica***) is a shrub of the family of rubiaceae native to Ethiopia **and/or Yemen, Arabia;** it is the main species cultivated for coffee production, being used at the end of the millennium in the Arabian Peninsula.

**CANEPHORA/ROBUSTA COFFEE**

***Canephora*** coffee is a species of coffee (***Coffea canephora***) native to West Africa. It grows mostly **in Africa and Brazil,** where a variety with the name Conillon is popular. It is also found in Southeast Asia, where French colonialists introduced cultivation to Vietnam in the late 19th century, and from there it moved to Brazil. It is easier to care for than the *Arabica Coffea* and cheaper to produce having an international market price below the value of the dollar. While *arabica* grains are considered superior, *robusta* is usually limited to lower grades in quality, although this division begins to be questioned by more accurately assessing the different properties of each plant. It is very commonly used to make instant coffee, and in low-quality

espresso blends to lower roasting costs. The *robusta* species has between twice and triple the caffeine of the *Arabica* species, as well as a high percentage of heavy materials. About a third of the world's coffee is *robusta.*

**DIFFERENCES COFFEE ARABICA AND CANEPHORA/ROBUSTA**

1. **Plant:** The height of the *arabica* is 2.5 to 4.5 meters, also grows between 1,300 and 1,500 meters of altitude, although sometimes it can grow at a lower altitude, it also requires an average tropical temperature of 15°C to 24°C. The height of the *canephora* is 4.5 to 6 meters, it grows from sea level to 600 meters of altitude.
2. **Caffeine: The** *robusta* variety has more caffeine than *arabica,* this gives a more bitter taste to the first, hence it does not have a very good reputation regarding its taste. Arabica has 1.5% caffeine, while the *robusta* almost doubles it with 2.7%.
3. **Other compounds:** Arabica has almost 60% more lipids (fats) and twice the sucrose (sugar) than *canephora,* this data and caffeine are the reason that most of the population prefers the taste of *arabica* to *canephora.*
4. **Price:** The *arabica* variety almost doubles the price of the *canephora.*
5. **Cultivation:** As we have just mentioned the difference in price, this has its reason for being in cultivation, for the ease in the case of *canephora* or difficulty in the case of *arabica.* An important data is the amount of chlorogenic acid (CGA) that contains the *robusta* which is between 7-10% and *arabica* between 5-5.8%, this acid is insect repellent that attack the plant, so the *robusta* is more naturally protected against pests or insect attacks.

6. **Use:** Normally we find the variety of *robusta* in instant coffee 100% and also in coffee blend (mixture of origins), it is also associated as it facilitates the cream so characteristic of Italian coffee.
7. **Shape:** The *canephora* variety is rounder and smaller, while the *arabica* is ovaler and large.
8. **Worldwide:** The *Arabica* variety accounts for 65%to 75% of the world's production, while canephora is only 25% to 35%. Brazil is the emblematic country of *arabica,* while Vietnam is one of the *robusta.*

| CHARACTERISTICS | *ARABICA* | *CANEPHORA* O ROBUSTA |
|---|---|---|
| **PLANT** | **Family:** *Rubiaceae*<br>**Gender:** *Coffea*<br>**Species:** *Arabica*<br>**Varieties:** *Typica and Bourbon*<br>**Height:** Grows from 600 to 2,300 m. above sea<br>**Root:** Deep<br>**Grain shape:** Oval<br>**Taste:** Acid<br>**Global production:** approximately 65%<br>**No chromosomes:** 44<br>**Time from flower to ripe cherry:** 9 months | **Family:** Rubiaceae<br>**Gender:** Coffea<br>**Species:** Canephora<br>**Variety:** Robust<br>**Height:** Grows below 600 m.<br>**Root:** Shallow<br>**Grain Shape:** Rounded<br>**Taste:** Bitter<br>**Global production:** about 35%<br>**No chromosomes:** 22<br>**Time from flower to ripe cherry:** 10-11 months |
| **CAFFEINE** | It has 0.8%-1.4% | It has 1.7%-4% |
| **OTHER COMPOUNDS** | It has almost 60% more lipids (fats) and twice as much sucrose (sugar) | You have lipids (fats) and half sucrose (sugar) |
| **PRICE** | Almost doubles the price | Nearly half the price |
| **CULTURE** | Crop difficulty<br>Chlorogenic cide between 5-5.8% | Ease of cultivation<br>Chlorogenic acid between 7-10% |
| **USE** | Mono origin or blend | 100% Instant Coffee<br>Coffee blend (mix of origins) |
| **FORM** | It's more oval and bigger | It's rounder and smaller |
| **IN THE WORLD** | Represents 65%to 75%<br>Iconic country: Brazil | Represents 25% to3%<br>Iconic country: Vietnam |

# GREEN COFFEE EXAM

## OLFACTORY EXAM

Before opening the bag or bag of the green coffee, we must write down in a tab-ficha all the characteristics of said sample, origin, name, date, no lot, etc... The sample should be placed on an orange or black surface. Next, we take the sample to the nose, as close as possible and write down the observations considering the following criteria:

1. **Normal odor:** characteristic smell of coffee or vegetable, no unpleasant or strange odour is detected.
2. **Abnormal odor:** any unpleasant odor caused by poor processing (mold, ferment, etc...), strange smell of coffee (smoke, fuel, chemicals, etc...), write down any type of odor other than coffee or vegetable. We can increase the odor from the sample by closing some coffee beans in a clean, odorless bag, hermetically closed for 1 hour or something else at room temperature. After this time, we open the bag to perform the olfactory analysis again.

## VISUAL EXAM

To perform the visual examination, we must spread the sample on an orange or black surface, under the natural light of the day (though not direct) or similar artificial light.

**Visual exam:**

**1. Botanical origin:** *arabica* or *canephora*, if we have the variety we write it down as well.

**2. General color:** describe it according to the PANETONE or color chart that usually ranges from white, greenish, bluish, orange or brown.

3. **Homogeneity:** the set of grains shows visual uniformity in size, color and appearance.

## ROASTING OF A SAMPLE

Sample roasting should have requirements such as:

1. Preheat the roaster between 170°C and 220°C+- 20°C
2. If the machine has been off for a while, make a little toast, which will not work for us.
3. The roast level must be clear or medium-clear, which is equivalent to 55 and 65 on the Agtron scale, according to the SCA.
4. The roasting process time will range from 8 to 12 minutes, handling the temperature and roasting speed during roasting.
5. Sample storage time: It should not be analyzed before 8 hours after roasting or exceed 24 hours. It should be stored in a cool, dark place, without cooling, in waterproof bags.

# CHAPTER 2.
# ROASTING STAGES

## 1. LOADING

When we load the green coffee into the roaster, it must be **preheated,** in this basic course we will not enter the different forms of preheating, in general it should be at a temperature of **170$^0$C** to **220$^o$C**. In contrast, the green coffee will be at room temperature, from 16$^o$C to 25$^o$C depending on the temperature we have in the room where we work.

Therefore, when the coffee beans enter the roaster, there is a **difference between the temperature of the beans and the roaster.** By the second law of thermodynamics, that material that is hotter transmits heat to the coldest, so the roaster emits energy in the form of heat, which will be absorbed by the beans. This way, the beans absorb energy that the roaster had, rising its temperature, and therefore the energy in the form of temperature inside the roaster begins to go down, because it is absorbed by the coffee beans.

This is why the temperature drops as soon as you introduce the coffee beans. During this phase, the only thing that happens is that the beans begin to rise their temperature to balance with that of the roaster.

## 2. DRYING

This stage starts right at the **inflection point of the temperature,** it is the returning point, this is where the roast curve begins to go back. At this stage the beans go through an

**endothermic reaction,** that is, the absorption of heat into the bean that causes such reactions inside, and that is that gases such as water vapour and $CO_2$ are generated..

Just a **dehydration** that does not affect the taste and aroma notes that we'll finally get in the cup.

It ends when in the extraction of the sample spoon, we already start to see the **yellowish** bean, which happens at about **140°C-150°C**, this is where the film begins, it starts to get interesting.

Including the previous stage, both will represent 70% of the total time of the roasting process.

## 3. DEVELOPMENT

At this stage **exothermic reactions** begin, this means that there are **chemical components inside the bean** that are affected by the heat, they begin to come out to their outer **part.**

**Maillard's** famous reaction occurs at this time, it is the glycosylation or non-enzymatic glycation of proteins, in practice, they are chemical reactions that will give the brown color to the coffee and aroma through chemical compounds housed inside the bean and that begin to come outwards.

At the beginning of this stage when the shades begin already brown is when we will hear the emblematic **"crack",** a crack that usually occurs at about **170°C**, the second crack occurs at **190°C.** The first crack is a point that will mark a before and after, from this moment is when the master roaster can take full potential to extract from the bean the qualities he wants, it is also when we should be attentive 100% to the process, because it is the final stages the most delicate ones, lasting between 1 and 4 minutes.

**a. Precrack**

At this stage, the chemical compounds inside the bean begin to come outwards, among them, **caramelization** occurs, exerting pressure towards the external walls, which will finally be heard as a crack in them, when they no longer hold the pressure and break. We should check the process in the sample spoon every 30 seconds if we want to be precise, although there are roasters that do it every minute.

**b. Postcrack**

At this stage, we need to be even more careful, it is the final stage where we must decide when to stop the roasting process. Here it should be noted that it is essential that we review the process in the sample spoon every 30 seconds. The reason is that the roast level is already more advanced, so the evolution of the roasting is accelerated, it goes faster, this means that in less time it is roasted faster, so we run the risk of burning it all more easily.

Until we remove the coffee, physical transformations continue to occur such as: increased porosity, displacement of oils towards the walls of the cell and darkening of color.

**c. Second crack**

This second crack tells us that we have already taken away the roast of the bean. It is not an indication that the flavor and aroma compounds we are looking for are being expressed on the outside of the bean, but it is a sign that the structure of the bean itself is very burned and is starting to disintegrate. At this moment,

we need maximum concentration, as a second of distraction can spoil the total roast. At this stage we obtain the types of South Europe: France, Spain and Italy.

## 4. COOLING

Once the bean is roasted, we must cool it so that it does not continue the roasting process with the inertia of the heat itself from the coffee beans. We must do it as quickly as possible to maintain the degree of roasting that we have developed.

With this cooling process what we get is for the bean cells to crystallize or petrify, so that the pores of the bean get sealed and preserved within themselves, the aromas and flavors developed to the point where we have stopped the roasting process. Thus, we can ensure the permanence in the bean of the characteristics that we want to express in the cup.

There are different methods, from the manual with a shovel and a fan, to the most common that is by extraction of heat. Ideally, this process should last between **5-10** minutes.

We will have to pack it after 24 hours, so it's finished cooling and the gases will be released.

# CHAPTER 3. PHYSICOCHEMICAL AND ORGANOLEPTIC CHANGES

The goal of roasting coffee beans is to get a delicious coffee drink at the end. Through the roasting process, what we get is for the raw green coffee beans to increase in size to almost twice, changing the color and density. By **absorbing heat,** the bean changes color passing through yellow, light brown, and finally dark brown, and even black. Its density decreases as the roasting continues. On the surface appear oils that come off the same bean, these also proportionally increase their presence on the outside of the bean as the grain roasting is greater; these lipids, along with other chemical compounds, are responsible for the taste and aroma of coffee, so the notes of these characteristics vary depending on the degree of roasting, which is what modifies the behavior of those coffee-specific substances. Obviously, the bean will continue the roasting until we remove the heat source.

During the roasting, then, modifications occur in the molecular structure of the coffee bean, so that it affects its physical-chemical properties, and its organoleptic characteristics. Next, let us set out the main modifications.

# 1. WEIGHT AND HUMIDITY LOSS

The weight loss of the coffee bean over the course of the roast ranges from **12% to 20%** of its original weight as green coffee. In the case of Spain, the most common roast has a loss of 17%. A maximum in this regard is that, **the higher the degree of roasting, the more matter is lost, and therefore more weight.**

The main reasons for the weight loss in the roasting are the loss of moisture, water that evaporates by passing the grain from 9%-13% to 2% in degree of humidity, also loses organic matter, gases such as $CO_2$ and other aromatic compounds, without forgetting a small percentage of the husk between 0.5% and 1%.

# 2. GAS FORMATION

The gases formed are mainly **$H_2O$** in the form of water vapor, **$CO_2$** or carbon dioxide, and aromatic gases. Due to the breakdown of organic molecules, $CO_2$ is released, forming **between 12 and 15 liters of this gas per kilo of coffee.** Therefore, it is not advisable to pack the coffee right after roasting it, being advisable to let it rest so that this gas is released before packing it, because we already know that it is not healthy.

# 3. VOLUME INCREASE

By subjecting the coffee bean to the high temperatures in the roaster, the water is transformed into gas and that creates a lot of pressure inside the bean. The interior of the bean loses matter, although filled with water vapor and $CO_2$ that has been generated, and pushes the walls of the bean outwards. All of this is what makes it increase in volume and lose mass.

Depending on the origin and roasting point, coffee beans increase **between 50% and 100% their original size.**

## 4. DENSITY

Density, both absolute and apparent, **decrease** as a result of volume increase and weight loss. The absolute or real goes from 1.25 g/mL to 0.7 g/mL in a medium roast, the apparent one can be easily measured in a specimen. This system, which we can carry out any of us in our workplace without any difficulty, consists of the following:

- We take two equal specimens, if possible with the measures marked to facilitate the task
- We take two coffees from different origins, although at first glance they are the same, we will be surprised by the difference they can have in density
- We fill the specimens with the green coffee, each origin in a different specimen
- We weigh the specimens with the coffee, separately
- The most heavy-weighted coffee sample contains the densiest coffee beans

Let us look at it with an **example**:

If the A container weighs 100 grams, and we have 100 beans (same volume as vessel B), each bean will weigh 0.10 gr

If the container B weighs 150 grams, and we have 100 beans (same volume as vessel A), each bean will weigh 0.15 gr

## 5. MAILLARD'S REACTION

This famous reaction really consists of a **process of non-enzymatic glucosylation of proteins,** which are the chemical reactions that occur inside the **bean** as it **absorbs** heat from the roaster.

Among the different reactions that occur, we have the production of **colored melanoidines** ranging from light yellow to dark brown, reaching black. These molecules can be observed in all the foods we subject to a heat source, as in roasted meats. For its reaction, it is necessary the presence of a carbohydrate (sugar) and an amino acid, this results in a new molecular structure that we observe in the form of color transformation and different nuances of flavors and smells so characteristic of coffee.

## 6. BEAN STRUCTURE. POROSITY

When heated from the roaster, the bean structure is becoming from being rigid and compact to less hard and more porous. This is thanks to **polysaccharides,** sugar molecules.

The **brittle and brittle structure** that is acquired in the roasting process contributes to the proper **grinding** of the coffee compounds in a soluble manner within the water, the last important step to obtain a quality drink.

## 7. BEAN SURFACE

Coffee is one of the plants whose walls are the strongest within this rhenium, they have rings in their external cells that give it that rigid appearance. Also, through its surface, there is a sweating of oils from the pressure suffered inside the bean, which is more intense to the greater degree of roasting. These **lipids** are the ones that help to keep the volatile chemicals of the

coffee bean inside, with the heat, they are extracted to the outside, giving the bean its characteristic aromatic and flavor **properties.**

## 8. COFFEE BEAN COLOUR

**Roasting levels:** blonde, cinnamon, medium, monk clothes, brown, dark brown, French and Italian.

This is one of the main characteristics of the bean transformation, its color. Before being roasted, the bean has a bluish, grayish or greenish color. As you get the heat inside the roaster, the color changes to yellowish, then to brown and if we follow it turns black, we all know, that the more heat you receive, the darker it will become.

Due to the action of the heat, the sugars of the coffee react with the proteins, giving rise to **polymers called melanoidines,** which we have already talked about, and which are responsible for this change of color, which will be more intense to the greater degree of roasting.

The color gradient is formed from the outside to the center. The difference in the range of browns is used as an indicator of the degree of roasting, in another section we will talk about the type of roasting in relation to this range of browns.

Looking at the color, it will also be seen that the husk comes off, a kind of paper that covers the bean, what we call **"husk"** and that the roasters extract through different mechanisms, so that the beans come out clean.

## 9. AROMA

During the roasting process more than **700 volatile chemical compounds** are formed, if we include those of the coffee when it is yet green, we reach more than 900. Of these, about 40 compounds are aromatic impact.

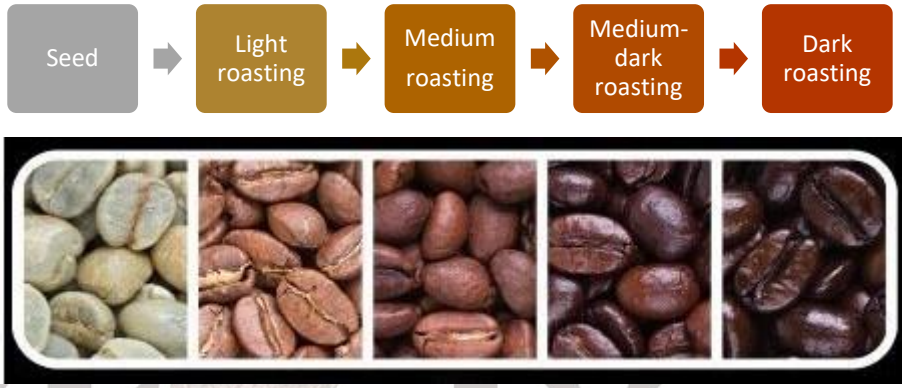
## 10. EXTRACTABILITY IN HOT WATER

For commercial roasts, the darker the bean, the greater the extraction, even the faster the roast, the greater the extraction. In the *arabica* variety the average extraction is 30% and in the *robust* 34%.

## 11. ACIDITY AND BITTERNESS

The higher the roasting, the lower the acidity in the cup. On the other hand, ***arabica*** coffee **is more acidic** (4.85 to 5.15 pH) than ***robusta*** coffee (5.25 to 5.40 pH) and, the latter is considered more **bitter.** It is not always adequately correlated with perceived acidity, so a correlation coefficient is established for its calculation. It should also be borne in mind that the **bitterness increases with roasting,** to the greater the degree of roasting, the greater bitterness.

# CHAPTER 4.
# TYPES OF ROASTING




## 1. LIGHT ROASTING

As the name suggests, it is a light roasting, this results in a coffee with low acidity, little body, with the highest degree of caffeine of all types of roasting. Its taste and aroma are fruity or caramelized, being able to distinguish the origin of the bean, a trace of grass is perceived. There are no oils on the surface, as it has not suffered major exothermic reactions. The appearance of the beans is dry and pale in color.

It is a healthier roast. It is the ideal coffee for filter or drip methods.

## 2. MEDIUM ROASTING

This type of roasting is somewhat darker than the previous one, it has more aroma than the previous one, in general, it is more balanced in both flavor and aroma. It also has less caffeine, the oils have not yet developed on the surface, but its caramelization is greater than in the previous roast, which gives it a sweeter taste as well as something more body. The appearance of the bean is still dry.

It is the typical roaster of the United States, so also ideal for the filter method.

## 3. MEDIUM-DARK ROASTING

This degree of roasting is already obtained after the second crack, do you remember that you have to be with bird eye here?, we find a darker bean color, with much less acidity, already more bitterness; it also offers lower caffeine content. The taste and aroma are more intense than in the softer roasted. Specifically, the taste can be sweet and bitter at the same time. Oils already appear on the surface of the bean, due to a more developed exothermic reaction and is a coffee with more body. The bean is oilier in its outer appearance and we observe that it begins to smoke, so there is already presence of roasted flavor.

This type of roasting is usually preferred by baristas to make a good espresso. It is typical of Spain and France.

## 4. DARK ROASTING

These coffee beans already have a chocolate brown or almost black color. Its surface appears shiny because in this intense roasting the oil of the bean sprouts much more to the surface. There is almost no acidity, no caffeine; on the other hand, we find a bitter taste with a touch of roast. The taste and aroma become intense and has a lot of body. It is the perfect match for espresso machines, are the typical cafeteria that pass the water under pressure (from 9 to

15 bar) for the coffee already ground. The appearance of the grain is black, oily and caramelized, resulting in a very dark cup coffee, with oil extraction.

It is the roast of Italian coffee and demanded by many baristas in the elaboration of their espressos. It is usually served only in a small cup.

## 5. TORREFACTO ROASTING

Of this type of roasting we will only mention that it is made with added sugar, it is increasingly used in fewer countries because it is not beneficial to health. The roasted roasting is contrasted to the natural roast, which is the roasting method of the previous four types.

# CHAPTER 5.

# SEKIO'S SEKRET: MAP

**Do you remember Sekio's Sekret: MAP?** Now we will reveal it to you, it is an action map that is easy to keep constantly present in your mind, it is the acronym for the performances that you must do to succeed with your roasting and brewing of coffee.


Yes, even **Starbucks,** to know what is the blend that will be most successful resorts to the system of giving people to try the final result in the cup, because, after all, it is what we are looking for, that the drink has a feeling of aroma and flavor as pleasant as possible for the person who will consume it. This last data is important, we must take into account that we do not all perceive the same coffee in the same way, this happens because our nerve endings of the tongue (taste) and nose (aroma) only send the information to the brain, which is in charge of giving the approval or not to the drink that is in the cup of coffee, and we already know that the brain of each one interprets things in its own way. Therefore, we do not all value the same coffee

in the same way, this means that, what for one is excellent, for another can be abhorrent. If you roast coffee for yourself, you can adapt the level of roasting to your liking, if you have as a roasting company, you will have to use the **MAP** method with your employees or even with people from abroad, the only way to know the roast that will have the most success.

Let's look at **Sekio's Sekret** somewhat more developed:

1. **Measure:** The first thing, obviously, is to measure the amount of coffee that we are going to put in the toaster, remember that we must calculate 80% of the capacity indicated by the manufacturer. When it comes to the toaster, the basic data to control a good coffee roast is the time and **temperature.** Likewise, the **measured data** of these and other parameters must be consistent, that is, that in each data collection all of them remain the same and there is only one variable, that we only change one data, in order to ensure that the observed difference comes from that data that we have modified (type of coffee, time or temperature), we must make a modification in each time we cough, we should not change different parameters or variables in one go, because then, we would not know which of them is the one that caused the change that we perceive, all this is done so that, when we have discovered the blend or the ideal roasting point of a monkey origin, we can replicate the toast by recording the recipe data in the software and get the same desired result every time we roast.
2. **A note:** In this second step we proceed to record the **data** of the parameters that we find most interesting in relation to the objective that we put, these results are not comparable between different brands of toasters, because this, in turn, is a parameter, is an important variable that changes the results. That is, we can have the same origin of coffee and roast it at the same temperature and with the same times, but if we do it

in two different toasters, we will get different results. Each toaster has different heat sources, different heat convection space, different drum rotation, and many more differences that will influence the entire roasting process, and therefore the final result of the grain roasting.

In short, we have to write down the temperature and time of the main moments of the roasting process as they are: the yellowing, the first crack and the second crack (if we get to it). In between we can write down the moment when certain significant changes in grain appearance occur, such as oil and color.

3. **Test:** The last point of Sekio's **Sekreto** is **to try,** in this concept we include what in the world of coffee is called **"cupping".** It consists of the following process; we pour the same amount of coffee beans into 4 or 5 cups or bowls. After grinding the coffee, we pour the different versions in the different containers, to carry out a dry olfactory analysis, thus analyzing the intensity of the aroma. Then, pour water at about 90oC,°and let it rest for about 5 minutes, so that all the coffee particles are infused, without any lumps left uninfused. Again, we perform the olfactory analysis by gently removing the coffee the same times in each cup, and cleaning the spoon between cup and cup. The next step is to remove impurities from the surface and wait 8 to 15 minutes to finally make the taste tasting, taking a teaspoon from each cup and spitting the coffee to simply appreciate the taste, we will look mostly at the levels of sweetness, acidity and bitterness.

# CHAPTER 6.
# READING TECHNOLOGY

The data provided by **sekio-Mitsubishi** software is a valuable help for the professional, who should not, therefore, disdain the traditional skills of roasting, therefore, it is still required that he have knowledge in this task, in the reaction of green grains to heat, in the control of time, in the domain of temperature, in the sound of crack, in the tone of color, in the aroma, and in conjugating all these variables with technology.

The main process is to obtain data from the toasted batches, but with different variables, that is, by changing the **temperature-time ratio,** so that, once we have achieved the desired roast, we can **easily replicate it,** with the help of **technology,** to ensure the same quality of toast **to** the final customer.

Let us go with the most relevant concepts that technology brings us to know how to handle them in our favor when it comes to roasting.

## 1. ROOM TEMPERATURE

We consider the **ambient temperature** as the one in the workplace. It can be measured with a simple atmospheric thermometer. The **green coffee** that we have stored or prepared for the next toast will have this temperature, also it will be the temperature from which the toaster will split before we heat it and reach the desired temperature.

It is obvious that, at a higher room temperature, the faster°the toaster will reach its desired temperature (from 170oCto 220oC),°but even more important is the speedor slowness at which the green coffee grain will reach that temperature after it is inserted into the hopper and poured into the toaster. Although there are different **methods of preheating** and loading, in this basic course we will only learn to preheat the toaster to the desired temperature, and then pour the green coffee into the hopper, which will then pass to the preheated interior.

Then, the **temperature curve of** the screen, which was between 170oC°to 220oC,°corresponding to the temperature insidethe toaster, starts to **fall,**let's see the reason for this fall. At the beginning of the roast there is a big difference between the temperature of the grain and that of the toaster. This occurs because we have preheated the toaster previously to the desired temperature and it has already reached it, data that is marked on the digital screen of the Sekio toasters. In contrast, **the coffee bean has the ambient temperature** of the enclosure in which we store it, since it has not yet received thermal energy, that is, it has not yet received the heat from the toaster.

The coffee mass that we put in the toaster absorbs thermal energy that is in it, thus decreasing the heat that was in the drum before inserting the coffee, let's say that the coffee beans steal heat from the toaster to heat them too. This temperature drop inside the drum lasts about 1 minute, and once it reaches its lowest point, called **the inflection point,**the temperature goes back, we can see on the digital display how the curve rises again. Both temperatures (the one inside the toaster and the coffee beans) will tend to **match at** this stage of the roasting process, and later continue to rise to where we consider; as a general fact, the temperature should rise by about 10°rC per minute in thosefirst moments.

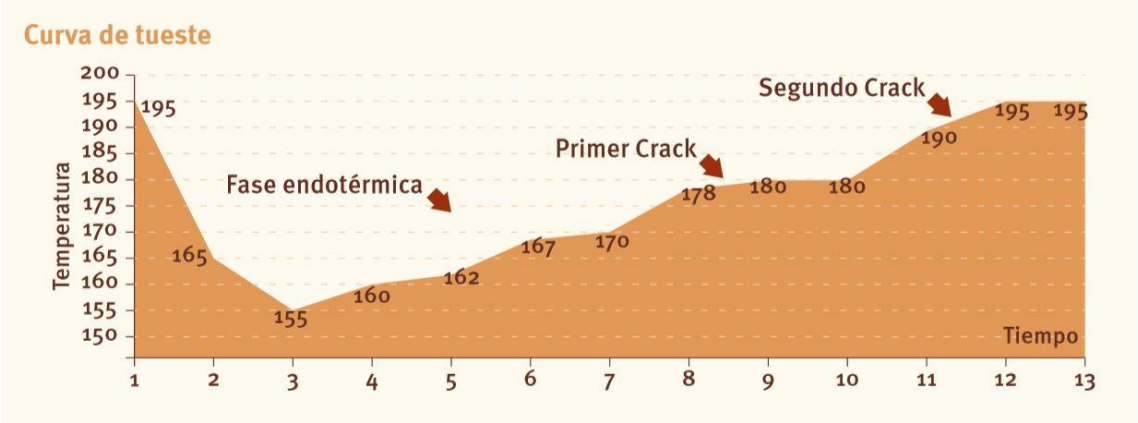
In short, the **roast curve** tells us three things:

1. If there is any **change in the** ambient temperature of the bass drum, if it goes up or down.

2. The **time** it takes for this temperature to change.

3. The **temperature variability index,**which is calculated by crossing it with the calculation of time. Both data (temperature and time) will guide our actions to set the amount of temperature and the rate of progression we want to have.

## 2. TEMPERATURE PROGRESSION CURVE OR VARIABILITY INDEX




Being an **index or ratio,**it is a data that indicates how the temperature changes over time in the roasting process. You may also find this concept with its acronym ROR **ROR** (Rate Of Rise-Ratio Upstream). The curve shown in the graph above is considered standard, it is only a reference, on it we will make the variations of temperature and time, annotating all this to know the changes that we must make in the ratio throughout the roasting process to make the most appropriate variations that give us as a result the degree of roasting that we seek with the characteristics that we want.

As you can see on the curve are indicated the main reference points when annotating the data:

1. End of drying phase (endothermic reaction)-beginning of the development phase (exothermic reactions)
2. First crack
3. Second crack

Specifically, the **variability index or ROR** tells us the number of degrees per minute that the temperature rises or falls. A **positive** change rate is called the temperature increase and **negative** when it decreases. It also informs us of how **quickly or slowly** the temperature is varying, this data should be our focus at certain times, especially at the end of the development stage, which is when the temperature degree range should be more controlled.

In the old days, due to the lack of technological development, there was no way to know what was happening inside the toaster, let alone the interior temperature in real time, today, with our own **Sekio-Mitsubishi**software, our toasters offer you the possibility to control in every second what is happening inside the bass drum.

This new technological possibility allows us to have real-time knowledge of what is happening inside the toaster and perform different actions depending on the data we are obtaining, in order to alter the roasting process to adapt it to the results that we want to obtain.

Technology allows us, in short, **to make forecasts,**that is, while we are tracking the temperature and observing the progression of **roasting** coffee beans, we can know what will happen and when, if we continue with those parameters, this is where the master roaster introduces his **craftsmanship,**conjuring it with technology, controlling the controls to achieve excellence in his recipes.

The intervention that we can do in the roasting process, mainly in the development stage, is **to increase or reduce the temperature,**with thisvariation, it is imperative to consider that we are also affecting the process in increasing or **reducing the evolution time of** the roast. For

example, if we want to highlight all the internal components of the grain related to aroma and taste, to achieve a very balanced end result, we can lower the temperature to lengthen the time of the roasting process and that the grain evolves more calmly, we can also finish the process before the second crack is heard.

As we can see, the **roast curve** becomes a guide to the next step that we have to make to get the toast we are looking for. Changes in both elevation and temperature drop are important turning points that we must take into account in deciding our next performance on the roasting process. For example, we know that if the roasting curve has a drop peak or negative **index,**it indicates that the temperature **is dropping** rapidly and the **roasting process is slowing down,**so that thegrains will become slower; on the contrary, if the roasting curve has a peak elevation or positive **index,**it indicates that the temperature **is rising** rapidly and the **roasting process is accelerating,**so that the grains will burn faster.

Another factor to keep in mind is that the reaction to these peaks in the curves should be complemented by the machine's knowledge and response time. As not all toasters have the same temperature drop response time or temperature drop after activation of the corresponding control, the times depend on the characteristics of each manufacturer, the size of the machine, the building material, the technology used, as well as other factors. Remember that we tell you how the toaster itself is itself a variable to consider in the roasting process, now you are seeing it more clearly.

You can also get the forecast of temperature progression in the future, so that you can react, increasing or decreasing temperature degrees, adjusting the roast as we see the reaction of the temperature curve. In short, the information that we can extract from this index can also be used to affect the chemical reaction of the roast, so that it can be manipulated by combining an increasing grain temperature with a gradual fall in roR, thus extending the time in which the grain passes through processes such as the Maillard reaction or caramelization.

All this technology not only influences the quality of the roast, but also the **very high energy efficiency** that **Sekio** brings in its toasters, and which is also supported by the infrared resistance system, in the case of electric toasters. We want you to know that our own engineering department together with **Mitsubishi** has developed highly sophisticated temperature control and regulation software, which enables that energy efficiency to our toasters. In addition, we are constantly innovating the technology of our Sekio smart roasters.

The **Sekio-Mitsubishi software** in our toasters allows you to modify the variables when necessary so that you can save the history of each modification and keep a record of all recipes.

At Sekio we want the professional to become an expert who anticipates the actions of the grain, rather than reacting after they have occurred, that is, that he can have control and make decisions for the future in order to get the desired final product, rather than reacting hastily to a situation of unforeseen or unwanted roasting.

And after testing different roasts, we want you to be able to memorize the recipe process so that you can replicate that excellence that you have achieved, as many times as you want.

## 3. TIME RATE IN DEVELOPMENT STAGE

It is the time that **elapses from the first crack to the end of the roast,**considering it as a percentage of the total roasting time.

When the **first crack** approaches and then to it, the roasting professionals react in many different ways, but we must keep the ratio **(temperature-time)** high enough for a positive index to continue that it allows the grain to continue its process without a more or less abrupt negative interruption. By maintaining a **positive temperature increase** we are keeping the temperature inside the bass drum so that the roast of the coffee bean finishes. In addition, this index or ratio

must give enough energy to the grain so that it can express its exothermic reactions, that if there is not enough thermal energy power will not occur correctly, thus losing the opportunity to obtain all the aroma and flavor potential that houses the grain inside.

If the **temperature index** turns **negative,**temperature is being lost inside thedrum. This means that, although the temperature of the grains may continue to rise for a while, this increase is due to the heat by convection inside the drum, the movement of the blades within it and the grains themselves, but, this temperature will fall, with the consequent result of a less coherent roasting within each grain. As we have seen above, if there is not enough temperature will not develop all the qualities of the grain.

Also, if the **ratio is very highto**, thatis, there is a high temperature and it is rising at a good pace, the grain will develop very fast, in this way the results obtained will be a grain with a great variability between inside and outside with respect to color (much darker on the outside than inside) and roasting (much more toasted on the outside compared to the inside, very raw inside). This is a sample that a lot has been done on the outside (very toasted), but little inside (more raw); nor has it had time for all its exothermic reactions to develop, so it won't have many taste notes, nor aroma, nor could caramelization show, because sugars haven't had time to come out. In addition, we complicate the control of the roasting process, which rushes and can develop more than desired.

Why is it so important to **measure the time** after the first crack?

The reason is that the grains are already open, so they absorb heat faster than previously, so that organic acids burn more easily after the first crack, and the most bitter compounds begin to emerge. Thus, the taste balance after the first crack goes from sweet-acid to sweet-bitter.

This rate of development time together with the final temperature at which it is pointed, result in the temperature and time range, which must be narrow, at which we must finish the toast.

In general, the first crack should occur between 8-10 minutes, and a total roast between 12 and 20 minutes. As we have already explained, this is one of the basic facts to control the roasting of coffee beans, it is a margin in which we must move. So, we must **measure and annotate** (remember **Sekio's MAP sekreto**?) the time-temperature readings when we found the **yellowingprocesses, first crack** and second crack **(if we get to it).**.

The **last stage of the roast is the most critical,**we must keep the temperaturestable, because the rate of roasting of the grain is higher, evolves much faster, so we want to look to keep the temperature to better control the cut of roasting. The longer we extend this stage the greater body and the lower acidity we will obtain, it is the typical Italian roast, if we look for flavors and smells the more fruity we obtain them with a lighter roast, so we will have to cut the process first.

Within this last stage, some professionals give a **final touch** in which **increasesthe temperature** for a few seconds, is even more critical. It is the culmination where acidity is decreased and the body increases.

Once we have finished the roasting process, we should analyze some grains, break them and see how they are done inside, to know if we modify something or not. Then, we proceed to the cupping analysis that we explained in Chapter 5. **Sekio's Sekreto.**

## 4. WEIGHT LOSS

We must start from the basis that the green coffee beans we have purchased are homogeneous and are not mixture of different sizes or degree of moisture.

Green coffee beans from different origins have different weights, different densities and different humidity levels, therefore there will be differences in weight loss between them.

When we know that **weight loss is high,**we should reduce the roasting time or lower the temperature of the charging time.

This weight loss data in coffee beans is tremendously relevant when calculating the **losses and profits of the coffee**business. It is a data that directly affects the cost of coffee, because, in the annual accounting, it is not the same to calculate moisture losses of 15% than 20%.

# CHAPTER 7.
# MAINTENANCE OF THE TOASTER

The **main economic investment** of any coffee roasting business is the toaster, so good **maintenance** is one of the keys to its **profitability,**optimization in its operation and extension of its useful life. In addition, the lack of maintenance of any food machinery leads in the medium term to poor quality in the product offered.

**Sekio toasters** are easily opened on the sides or elsewhere, depending on model, in order to facilitate this task or any other technical one.

In the case of the coffee toaster, the following occurs: In the ventilation ducts and cooking parts of the coffee, substances from the roasting process are accumulating. One of the sources is the oil of coffee beans itself, another is the remains of the hydrocarbon, in this case, usually the gas, which when condensed forms a layer of tar especially in the ventilation ducts.

These **solid substances** are deposited in different parts of the toaster causing several negative **consequences:**:

1. Restricts the airflow in the vents when deposited in them.
2. Coffee beans are coated with these residues, then taking notes of unpleasant taste.
3. Risk of fire due to the possible combustion of the waste themselves.

The solution is to create a **cleaning and maintenance program.** And most important of all, **DO IT!!!** This program should be set as follows:

1. The most common **daily cleaning** is the extraction of the shell, this will depend on the capacity of the container of the debris of shell, it can be every 3 or 10 toasts. The cooling tray must also have all the holes clean so that it can pass through the air.

2. Weekly **cleanings** will consist of treating in more depth those less accessible and untreated parts on a daily basis. This cleaning is very comfortable to perform with a vacuum cleaner or air gun from a compressor. Some moving parts can also be greased with food fat and high temperature.

3. Depending on the use, a thorough cleaning and maintenance programme should be established **two to four times annually.** This program involves disassembling the machine as much as possible, and cleaning with the products recommended by the manufacturer. Thus, we extract the remains that accumulate in pipes or different corners of the toaster, so that the roasting profiles remain the same. Fans and extractors will be thoroughly cleaned as they easily accumulate the above debris.

4. An **annual review** will require even more depth in cleaning the more technical sections of the total installation, not only of the toaster, but of other surrounding ducts or parts. If necessary, more specialized external aid will be used using the manufacturer itself or other technicians.

5. **Attention:** It is important to be aware of possible gas leaks, metal sounds or friction between parts. These are habits that we must accept as a prevention of possible future problems.

6. **Material:** In addition to the aforementioned vacuum cleaner or compressed air gun, it is recommended to wear a mask, goggles and gloves. Solvents and degreasers, including TSP or trisodium phosphate mixed with hot water, can also be used.

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