One of the wonderful things about coffee is how responsive it is to all the nuances and variations in growing, processing, roasting and brewing. In the roasting especially, these touches have a magic all their own. Enough to make us love the process, think big thoughts, and want to dive in again and again. Why is that? Its because, the more we look the more fascinating the whole process becomes, because in coffee roasting, as in all good magic, there is more going on than readily meets the eye.

Investigations into the chemical content of coffee have revealed an astounding complexity. To date more than 1500 compounds have been identified in coffee and researchers continue to estimate at least 20% of coffees chemical make up remains unknown. With such complexity and the added complexities of selection, growing, processing, and regional differences, its no surprise that coffees offer such a diverse array of character and potential for the roaster to work with. Understanding this array of gross and subtle aromatic and flavor variations of each specific coffee, and relating those to the selection of roaster controls in order to maximize virtues, minimize faults, and achieve repeatable desired results, is the essence of the art of roasting.

The first part of this process for the roaster is to discover the potential of each coffee. Each coffee offers a spectrum of possibilities, and although coffee is complex we can begin to uncover a coffees potential by looking first at the two key elements of acidity and body. The chart below illustrates in a very basic way the relationships of these characteristics to the general level of roast degree.

![Diagram](image)

As can be seen clearly in this diagrammatic view, whatever acidity a coffee may have to offer will be maximally accented at lighter degrees of roast. This is not to suggest that acidity will decline in a purely linear fashion with all coffees, or that all light roasted coffees will have
acidity. Nevertheless whatever acidity is present will be greater at lighter roasts that at darker roast levels.

Body is also a key component of the character of any coffee and likewise responds in its development to the roasting cycle as illustrated in the graph below.

Unlike acidity, the body of a given coffee is very low at lighter roast levels. In fact it might be fair to say, that until a coffee is roasted into mid range roast levels of at least the beginning phase of the second crack, we may remain quite unaware of what potential body a coffee may possess. Additionally, though the body of the coffee will increase into the deeper roast levels there is a limit to this increase. As a coffee begins to approach the very darkest roast degrees its body as well as its acidity will decrease.

Clearly from one coffee to the next the potential degrees of body and acidity will vary considerably. Nevertheless we can say that for a given coffee there will be a point in roast degree where both body and acidity will be in relative balance. This can be thought of as the point of a given coffees equilibrium, and although useful in the analysis of a coffees potential it is not necessarily the point where the best flavor and aromatic potentials will be found.
In this particular illustration we can see that this coffee reached its balance point for equal acidity and body at a medium level of roast. In another sample we might well find that this balance point is significantly shifted to either a lighter or darker roast.

But of course acidity and body are not the only elements to consider in analyzing and appreciating a coffee's character, aroma as well plays a major role in our enjoyment of coffee. Considering aromatics is actually quite essential as it is generally in the aromas that we can make significant assessments of coffee quality. This can be especially helpful in guiding us in considering what kind of time temperature profile to apply in roasting.

Reducing to graph form how roasting parameters influence the spectrum of aromatics, is no easy task. In fairness to our coffees it is in fact probably impossible to do so without lopping off a whole range of nuanced subtleties that coffee aromatics contain. Nevertheless we can make a crude working model of how roasting influences aromatics and relative levels of acidity and body in the following way:
Even though this model gives us a rough idea of which aspects of a coffee’s character will be emphasized at a given roast level, it in no way gives us a clear profile of how a specific coffee may react and develop. This can only be discovered by taking a coffee and roasting samples across the roast degree spectrum. “Spectral” roasting and cupping allows us to discover the relative strengths, weaknesses, and subtleties, of each coffee. In doing so what is quickly uncovered are the roast degrees wherein a particular coffee shows its greatest virtues. For some coffees this may be only one or two points along the spectrum and anything outside those points the coffee simply fails to deliver anything special. For the best of coffees we will find that they respond well to virtually every degree of roast and at each degree present another facet of their special and desirable character.

However the most common result will be the discovery of multiple points wherein the roast flavor is highly desirable yet unique as it moves along from light roasts emphasizing acidity and bright vivid aromas but with little body, to medium roasts with a balance point of body and acidity with deeper perhaps richer aromas, and further into deep roasts that accentuate body over acidity and rich aromas but without the earlier aromatic complexity, and then finally into the darkest roasts where body also begins to diminish and the carbony notes of flavor and aroma take over most of the coffees individuality.

Each roast master will have to select for themselves how many points across the roast spectrum they want to roast and cup. For some that choice may be limited to the roasting range the company is focused on, for others the range will cover the entire spectrum and here some practical decisions need to be made. One guideline for this choice might be the Roast Color Classification System developed a few years ago by the SCAA. In this system eight levels of roast were selected as spanning the potential spectrum of quality roast degrees. These ranged as follows with corresponding Agtron M Basic levels:

1. Very Light 95
2. Light 85
3. Moderately Light 75
4. Light Medium 65
5. Medium  55
6. Moderately Dark  45
7. Dark  35
8. Very Dark  25

What is not made reference to in this classification or in anything discussed so far is how the speed of the roasting cycle may also affect coffee character. Some years back equipment designers began to engineer roasters that were capable of reducing roasting times considerably. Conventional 15-minute roast levels were achieved in less than 5 minutes. The results of these designs proved quite interesting on several levels. For one the beans themselves were appreciably larger in volume having generated greater internal pressures due to the heat transfer building much quicker than normal and the internal bean pressure not having the time to release as fully during roasting. But more significantly the acidity of the coffee was also greatly enhanced.

Although the level of enhancement may or may not be desirable for a specific flavor target objective, understanding that it can occur, is useful in selecting the roasting profile for a given coffee. The following chart illustrates this principal.

Understand this principle allows us to return once again to our spectral roast sampling and consider how we might utilize the boost in acidity a more rapid roast can achieve with the fuller development of body that a darker roast can create. Once this is really understood then the possibilities of achieving varying flavor profiles while maintaining the same degree of roast, opens up another level of creativity for the roast master. The following chart combines a view of three samples with widely varying time temperature profiles but with equal final roast degree levels.
As illustrated, samples 1, 2, and 3 have each achieved an Agtron roast level of approximately 60. However what is significant to note that is each case the overall roasting time and temperature vary considerably, and the flavor and aromatic profiles will likewise exhibit significant and easily discernable differences. While this may not enable roast masters to create the proverbial silk purse out of a sows ear, it does undoubtedly give a very significant added capability in deriving flavors and aromas that otherwise would remain unexpressed.

Of course even though we may understand the principal of how major shifts in roast speed can alter coffee character we may be constrained by the limits of what a specific roasting machine is capable of. In the past the achievement of rapid roasts versus conventional roasts also meant the investment in separate roasting machines each designed to work with one spectrum or the other. However some select breakthrough roasting designs today have transcended this limitation and offer on a single roaster the ability to selectively adjust a whole range of operational parameters that can allow full batch roasting to targeted roast degrees achievable anywhere from a high speed 3 minutes out to more conventional speeds of 15 minutes or more according to the operators choice of settings. There is no question that the options available today are marvelous. However even with the best equipment we can still run the risk of roast induced imperfections if we stray outside the limits a quality roasting spectrum that is always a marriage of both bean and machine.
As our final chart aptly illustrates, as long as roast masters keep a watchful eye on the excesses that can ruin the best of coffees, there remains a wide spectrum of wonderful coffees for the palates of coffee lovers everywhere.

With the production and lab equipment available today roast masters can develop wonderful coffees bringing out the full range of flavor and aromatic nuances, with a complexity, sophistication, and programmable repeatability never before available. Yet as in all the history of coffee there will never be a substitute for good cupping training and the sensitivity of our palates, and, just as importantly, the palates of our customers.

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