

THE ROAST TIMES

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Lillie Brothers Hope to Hit the “Bullseye” With New Roaster

Aillio is adopting an innovative approach to in-house roasting that they think may revolutionize the specialty coffee industry

“This will be the Rolls Royce of roasters for coffee shops,” said Jonas Lillie, “Get ready”

Jonas is the founder of coffee roaster manufacturer Aillio Ltd. and he is talking about a new project code-named “Bullseye” -- a roaster him and his twin brother, Jacob, are designing specifically for cafes to roast in-house with.

“In the past, cafes had to worry about the physical space that a roaster takes up in a cafe, as well as figuring out a way of dealing with the smoke, not to mention dealing with gas and all the cost associated with setting that up,” he said. “Our new roaster solves all these problems, and more.”

With a footprint less than 2 by 1 feet, the machine takes up less space on the busy cafe counter than a typical espresso machine. And it plugs into any standard 220V outlet. Perhaps most importantly, almost all features can be automated, freeing up the barista behind the counter to focus on their most important job: servicing customers.

The idea is this: Once a particular roast profile is dialed in, it will be possible to duplicate that profile with little time or effort. One simply weighs out the coffee, hits the start button, and walks away. Less than 15 minutes later, your

roast -- already cooled -- is ready for bagging.

According to Jonas and Jacob, the automation is really what makes the roaster ideal for use in cafes. This is because a high capacity (5kg or more) roaster is too large for most cafes to accommodate, but roasting in a commercial setting with batches less than 5kg is an inefficient use of time, as staff will need to watch each roast carefully.

“The solution is automation,” says Jacob. “We are trying to recreate the perfect roast without any user intervention. It's all about reducing variables.”

In order to achieve their goals, the brothers have been developing a great deal of new tech, including a new way to measure bean temperature during a roast.

“I’m most excited about the infrared bean probe,” Jonas said, “It gives real-time readings with no lag. Standard bean probes are inconsistent and laggy. They can't keep up. It's a relief to have something better.”

The new roasting system also includes a power PCB capable of handling variances in voltage, an air cleaner, a variety of new internal sensors -- some of which are still in development and have never been seen before -- and the



ability to precisely control the temperature of air flowing into the drum. Taken together, the brothers hope these unique features will change the way people roast their coffee.

“We want to make this process as simple as we can,” explains Jacob. “Of course, there is still a great deal of craft involved when it comes to perfecting a particular roast profile for a bean.”

“But once you find the right way to roast a bean, we want to make it easy for anyone, even inexperienced baristas, to repeat that recipe again and again. And we want people to be able to share those recipes with others online, too.”

Users will also be able to adopt some unique approaches to roasting, including the ability to adjust the ratio of convective and conductive roasting via the heated airflow. And, in keeping with the philosophy that gave Bullet R1 users a variety of updates over the past couple of years, the Lillie brothers are designing this new roaster with the intent of offering future upgrades.

“We’re going to be learning a great deal about roasting from this machine, and we want to be sure that we can put our new knowledge to good use,” Jonas said. “That’s why we’re looking at a modular design to accommodate future upgrades. We envision this machine aging like a fine wine.”

When pressed to comment on some of those upgrades, his brother Jacob smiled. “I’m not at liberty to disclose that information,” he said. “I’ll guess you’ll just have to use your imagination.”



Lillie Brothers

Roast Science Special: Is Infrared the Future?

New Technology is Delivering a Cleverer Way to Measure Bean Temperature During a Roast

“Data-driven coffee roasting has always been an inexact science. Your roast profile is always telling you little white lies,” Jonas Lillie, CEO of Aillio, said with a laugh. “It creates a lot of uncertainty. And we thought we could do better.”

To understand the value of Aillio's new infrared bean probe, you have to first understand the limits of traditional probes. And that's going to require a little science class.

Roast profiling, or the plotting of bean temperature data over time, has revolutionized the way people think about coffee roasting. For many, rightly or wrongly, shapely profile curves have become synonymous with a good roast. The data used to generate those curves is produced by temperature probes placed within the coffee roaster. These probes come in many flavors, including thermocouples, and RTDs (Resistive Temperature Device.)

Both thermocouples and RTDs pair two dissimilar metals in a casing and measure their reaction to changes in temperature. In the case of thermocouples, as these dissimilar metals heat and cool, they generate an electromotive force which can be measured in volts and translated to temperature readings. RTDs, on the other hand, measure the electrical resistance between the two metals, which changes as temperature does. This disparity can also be translated into temperature readings.

It all sounds great on paper, but these probes are, ultimately, only a proxy for the bean. They can only tell you how hot the probe itself is. In other words, the curves on your roast profile graph are a plot of the bean probe's temperature, not the actual bean temperature. This is a problem.

For instance, because a bean probe is primarily heated by conductive

heat from the beans, and because a smaller batch may do this less efficiently, it often appears that smaller batches reach first crack at lower temperatures, even though they don't. This makes it extremely difficult to compare bean probe data across different batch sizes.

The placement of the bean probe in the roaster can also affect temperature data. In some roasters, for instance, thermal energy may also migrate from the front plate of the roaster to the probe, too.

And even the bean probe itself is a sea of variables: in some cases the casing of the probe is thicker, which causes the metals inside to heat up more slowly. In fact, there is always a lag between the temperature of the probe and the actual temperature of the bean itself. Even in the best scenarios, this lag is not inconsequential and may in fact exceed a full minute. This means that you are actually peering into the past while watching a live

roast profile, and can only guess at what's really happening in the moment.

So although traditional bean probes can be very helpful, there is a limit to what they can tell you about the roast. This is particularly true when it comes to sharing data among users -- with so many variables at play, how can one attempt to duplicate another's roast armed only with a profile?

Infrared sensors work differently. They measure the amount of light of a specific wavelength (known as infrared) emitted by an object. This reading tells us how hot a given object is, though all infrared probes must first be adjusted to the 'emissivity' of the material they are measuring, as different materials can be more or less effective at emitting thermal radiation as they heat up. But once the emissivity is set to match that of roasting coffee, the temperature readings will be quite accurate. And -- importantly -- very, very fast. By eliminating that lag, a great deal of guesswork is also eliminated. There is no more need for time-traveling in your head.

It may seem obvious that an infrared sensor enjoys many advantages over traditional probes. So why isn't everyone

using them? Well, coffee roasting is a messy business. Those little green beans seem innocent enough when you dump them in, but once the roasting process begins a plethora of chemical reactions are initiated, producing a smoky, oily environment. The steam and soot from the roast quickly coats the sensor and affects the readings dramatically.

“How to keep the sensor clean was the biggest hurdle to overcome,” Jonas said.

The answer was to be found in a patent-pending design dreamed up by Jonas one day. It utilizes a jet of air to keep the sensor grime-free. Parts were purchased and a prototype was quickly 3d-printed, and soon everyone in the Aillio office was excited about what they were seeing.

“It didn't matter what the batch size was, or the bean-type,” he said. “All of them were reaching first crack at just about the same temperature. We could see the data side by side and the new infrared sensor was far more accurate than the traditional probe we'd been using.”

(Continued on Page 2)

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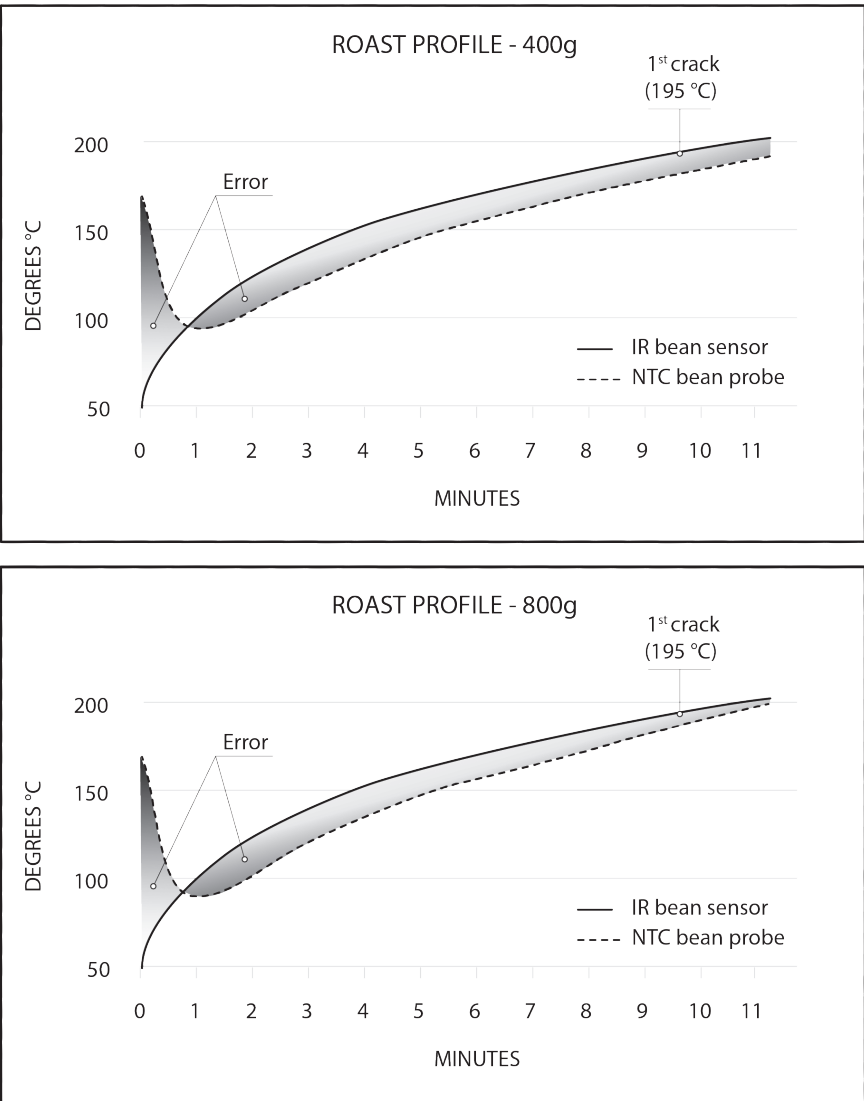
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(Continued from Page 1)

As the chart beside shows, the traditional bean probe first-crack readings vary wildly -- up to 20 degrees -- according to the amount of beans being roasted. But the IR sensor shows the beans cracking at approximately the same temperature, regardless of batch size or roasting speed. This consistency is the holy grail of the profiling world. It makes your own data more useful to others and vice versa.

Now that roasters can finally see what's actually happening on the surface of the bean in real time, who knows what they will learn about coffee roasting through this new technology? For instance, it could be that 'stalling' a roast (with a negative "Rate of Rise") is more common than we imagined, and that the smooth ever declining positive RoR is really something of an artifact caused by probe lag.

"One of the things that makes coffee so exciting is how little we actually know about it," Jonas said. "The IR bean sensor is a new tool for learning, and that is... super cool!"



The Evolution of the Bullet R1



Ready for the R1v2? Aillio has some important upgrades planned, but won't leave early adopters behind.

When the first pre-order models of the Bullet R1 began shipping two years ago, Aillio was finally able to breathe a sigh of relief. What had begun as a controversial concept based around the power of induction heating

had been made real -- the thing was built! -- and the feedback from those first models was positive. The machine was performing as well, or better, than everyone had hoped.

"Of course, it was far from smooth

sailing from a manufacturing standpoint," CEO Jonas Lillie said. "There are always hiccups along the way. But the design was solid and people liked it."

Still, these past two years have seen Aillio trying to improve the

roasting experience for Bullet R1 users. As the months rolled by, the company experimented with numerous ideas, some of which didn't work, but others that did. At times, the office seemed more like a science lab than an office, with machines such as 3d printers, laser cutters, oscilloscopes, and specially built power supplies easily outnumbering the staff.

The team has developed new heatsinks to better protect the internal electronics, a new chassis design with the same goal, new chaff filters that allow for better airflow with fewer cleanings, and a metal spring for better motor stability.

They've also added a silicone moisture protectant for the control PCB, and countless firmware updates that have improved the performance and stability of the roaster. Without exception, the company has made these upgrades available to all users at a very low cost, or even for free.

"We have been overwhelmed by the support we've received," Jonas said. "The community has been really amazing. Wherever we go in the future, we want to take them with us."

Which brings them to next evolution of the machine, the Bullet R1v2 (version 2). It will ship with brand new infrared bean temperature sensors that can produce real-time

measurements of bean surface temps -- technology that Aillio believes will revolutionize roast profiling -- and a custom-designed power PCB that will allow Aillio to improve both its error handling and its power management.

The new model will sell at a slightly higher price than the old one, but in keeping in line with their past commitments to their old customers, Aillio will be offering an upgrade kit for Bullet R1 users. The price will be the difference in cost between an R1 and an R1v2 -- about US\$200.

There is a rationale behind this move, beyond just spreading goodwill. In Aillio's opinion, the infrared sensor is such a major improvement that it would be counterproductive to restrict it to those who purchase the newer version.

"Because of the nature of the infrared bean sensor, the quality of the data will be much improved," Jonas said, referring to the ability of infrared to provide more consistent roast profile data than the older bean probe, regardless of batch size. "Of course we'd like for everyone already roasting on a Bullet to have the same opportunity to put that data to good use. The more people using this sensor, the more we're gonna learn about roasting coffee. And that's why we do what we do, to learn more."

Center for Coffee Research & Education at TEXAS A&M Promises to Change the Way We Think About Coffee

Leo Lombardini arrives at the Center for Coffee Research & Education (CCRE) at Texas A&M University each morning with a very long to-do list.

"There is really no typical day [here], but that is part of the excitement, because every day brings something new and because most of the activities revolve around coffee," he wrote via email.

Lombardini is the Director of the CCRE, and much of the work he is doing is born from necessity. The *Coffea arabica* plant we all know and love is in grave danger, and that puts a great many farmers at risk, too. Some recent studies predict that by the year 2050, over 50% of the land used to grow coffee today will no longer be usable.

"Climatic variability poses a serious threat to the world's coffee. Yields

have already been seen to decrease up to 80% in marginal areas lacking irrigation," said Lombardini.

"Drought during the rainy season is of great concern and widespread, affecting yields in the majority of producing countries. Climate change also influences pressures of pests and diseases (such as the coffee berry borer or leaf rust) on coffee."

Fortunately, there is hope. The CCRE is currently growing about 150 Arabica plants from seeds sourced from different parts of Ethiopia. These will be soon be carefully studied in order to identify traits that can help the plants stand up to environmental stresses such as drought and heat.

Harnessing these traits would mitigate the dangers presented by climate change, and crossbreeding could be the key to achieving the goal of sustainability. When genetically distinct parents are crossed, the resulting hybrid is referred to as an F1, and these F1 varieties show a great deal of promise in terms of quality, production, and disease resistance.

Already, there have been successes.

"We will soon evaluate the sensory characteristics and chemical profile of coffee harvested from a new leaf-rust-resistant hybrid called Centroamericano. This hybrid scored 90.5 in the recent 2017 Nicaragua Cup of Excellence, marking a major win for the development of F1 hybrid types," said Lombardini.

But the team is tackling climate change problems from a wide variety of angles, not only genetics. And much of the work being done addresses concerns across the industry.

"The strategy of our "Coffee Resilience for Central America" project, which is funded by USAID, is to focus on climate-smart coffee production, better crop and



Texas A&M University researchers studying the science behind coffee flavor and aroma.

environmental management and on opening doors to economic opportunities within the coffee value chains", Lombardini said.

The team will be looking at how to reach out to women and at-risk youth in hopes of delivering coffee careers in everything from nursery management to third wave baristas. The idea, ultimately, is to create a fair, smart, and sustainable industry with key environmental and economic considerations directly woven into its fabric.

Other projects include a proposal to investigate, through chemical analysis and expert sensory evaluation, the freshness changes coffee undergoes after roasting.

And a certified Specialty Coffee Association Campus is planned to allow for in depth post-production research.

The CCRE is also collaborating with companies in the industry to facilitate their research. It most recently announced a partnership with Aillio, manufacturers of the data-driven Bullet R1 coffee roaster.

"Not only will the partnership allow us to conduct and report about our research, but it will also be instrumental in developing teaching and training activities for our students and the representatives of the coffee sector", Lombardini said.

Roast.World Launches in Beta With RoasTime Integration

The willingness to share the love and knowledge of coffee with others in the community is what drives innovation within it.

It's a simple idea, but very ambitious, too.

"It is a place for people to share their coffee roasting experiences in order to make better coffee," said Daryl.C, lead developer of RoastWorld, a new website built specifically for lovers of specialty coffee.

The website, still in beta (<https://beta.roastworld>), aims to be a space in which all things roasting-related can take place, geared toward both professionals and amateurs alike. For instance, it will allow green bean suppliers to connect with new customers, and provide a means for cafe owners to make smart decisions all the way from purchasing the right green beans, to managing stock, to roasting their beans in the way that best captures their uniqueness.

And it will give hobbyists a chance to analyze what went right -- or wrong -- with their roasts. Perhaps most importantly, they will be able to learn from those with more experience by looking at how they roast particular beans.

"Right now the most exciting feature is the Roasts Analyzer," said Daryl. "It lets you compare your profiles with others and thus improve your roasts."

As anyone acquainted with the specialty coffee industry can attest, the willingness to share the love and knowledge of coffee with others in the community is what drives innovation within it. For this to work, then, everyone will need to jump on board, and that will require useful features to draw users to the site.

These include the ability to search for roast profiles of particular beans from particular vendors, to directly comment on the roast

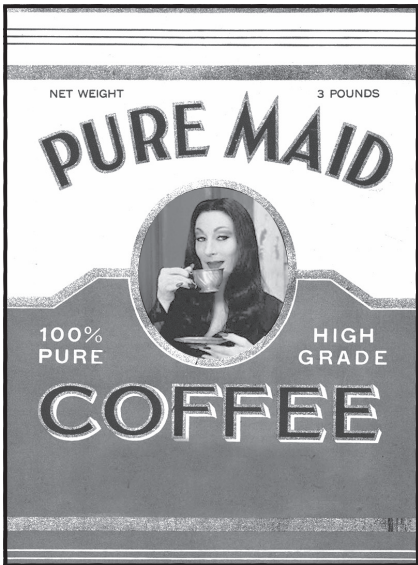
profiles of others, and even to share cupping results of a particular roast with the world.

One of the more novel features planned for the future is the ability to index, rate, and share "Roast Recipes" independent of particular profiles. These recipes will consist of a series of actions -- adjusting power or fan speed, for instance -- that occur when specific conditions, such as bean temperatures, are met.

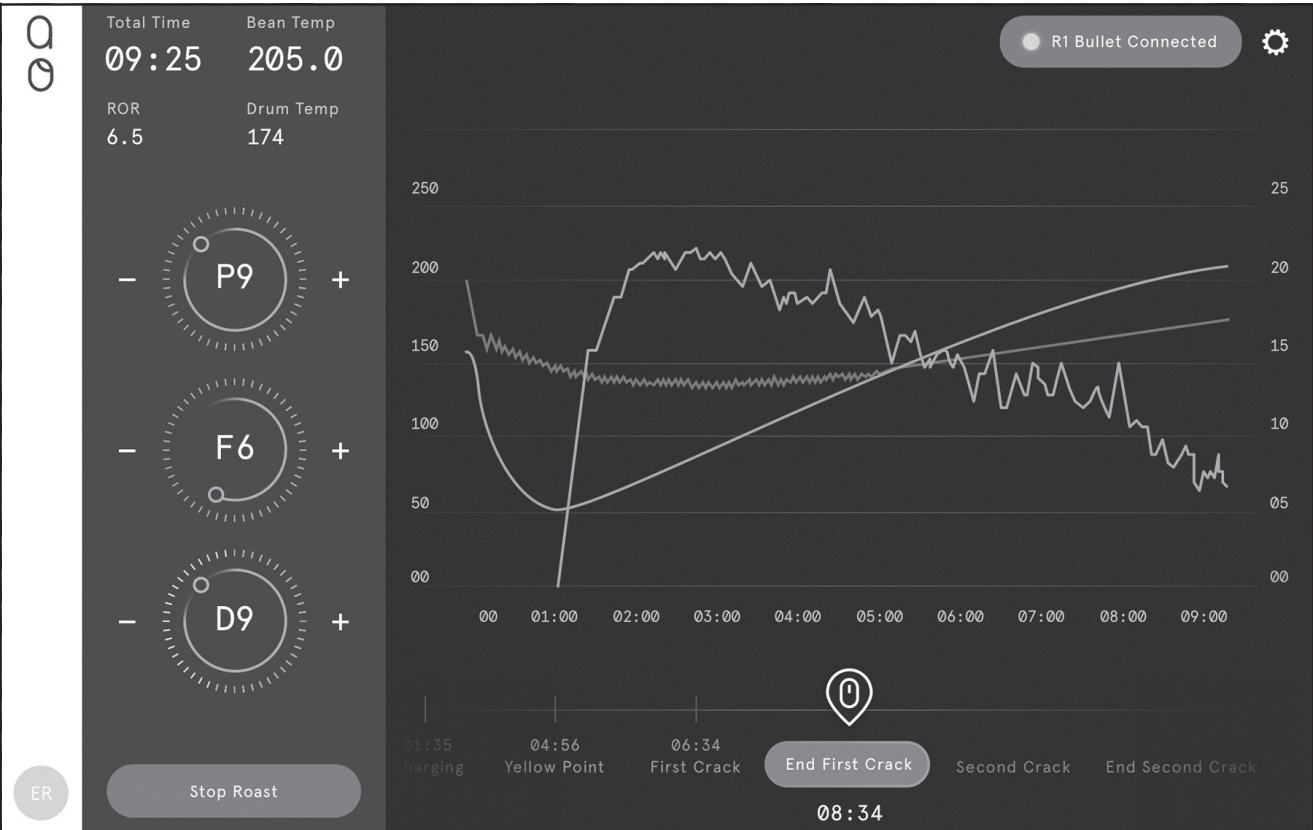
For the time being, RoastWorld is primarily geared toward owners of the Aillio Bullet R1 roaster, whose RoasTime software directly interfaces with it. This will allow Bullet users to run Roast Recipes from RoastWorld automatically, with no manual inputs.

"But one day we hope RoastWorld will be able to analyze different roasting profile formats from any roaster," Daryl said. "With a public API for developers to build their own tools using resources from the site."

After all, sharing means caring.



New RoasTime Software Floats on the Cloud



Now when a user roasts on the Bullet R1 using the new software, roast profile data is stored on the RoastWorld (<https://beta.roastworld>) website.

Developing roast profiling software from scratch is a daunting task. Especially for someone with little experience in data-driven roasting.

"I had been roasting coffee for about 2 or 3 years before I began working on the Bullet R1's software. But that roasting was not in any way scientific or data-driven," Jacob Lillie said. "It was more sensory. Visual."

Jacob is the head developer of RoasTime, a software program developed specifically for the Aillio Bullet R1 coffee roaster. As the first prototypes of the machine rolled out, him and his brother Jonas, the R1's designer, were presented with a choice: utilize existing software or develop their own.

We wanted something simpler...

"At that time the other software seemed impossible to use," Jacob said. "Some of it had so many

features, we couldn't figure it out. We wanted something simpler. But making it user-friendly was probably the most difficult part. Just figuring out what was required was hard."

Over the course of a couple of years, the original Windows-based software has gradually matured into a feature-packed roast profiling program. But eventually, the number of users clamoring for Mac support reached a crescendo.

"We always planned to have Mac support," he said. "But we didn't plan on so many of our users wanting it so badly. But actually this became the start of something brand new."

After considering a variety of options for porting his software to Mac, a dramatic decision was made. He would need to start from scratch again.

"I brought in a new programmer, Matthew Camp, to take over for me," Jacob said. "It's a complete rewrite of everything but using the latest technologies for software, and integrating it all in the cloud, which opens a lot of possibilities for the future."

Now when a user roasts on the Bullet R1 using the new software, roast profile data is stored on the

RoastWorld (<https://beta.roast.world>) website. Although both the new RoasTime and RoastWorld are still in beta, roast profiles can already be shared with other members of the site, allowing everyone to learn from each other.

In addition, Aillio will be able to look at this data in total to learn a great deal about roasting coffee in general, and about roasting on the R1 in particular.

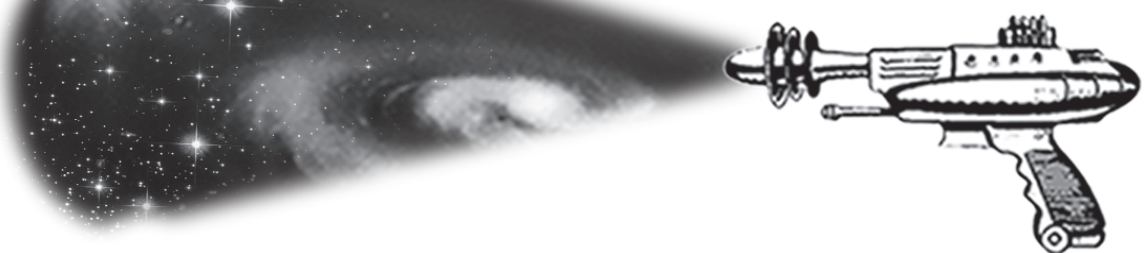
"Machine learning is definitely something we're looking at. AI, if you will," Jacob said. "We want to enable users to create a roast profile on their computer with all the known limitations of the Bullet. So you will not be able to create something that the Bullet can't do. It will feel fully automated. Based on data and learning from all the different Bullets we have out in the field."

In addition to Mac, the new version of the software is also already available on Linux, with a Windows release scheduled soon.

"The old Windows version that I wrote originally will be slowly phased out," Jacob said. "We're moving full steam ahead."

Sick and tired of coffee that tastes like ashes in your mouth?

Our patented technology will turn back the roast-clock and restore all those wonderful flavors you believed were lost for good!

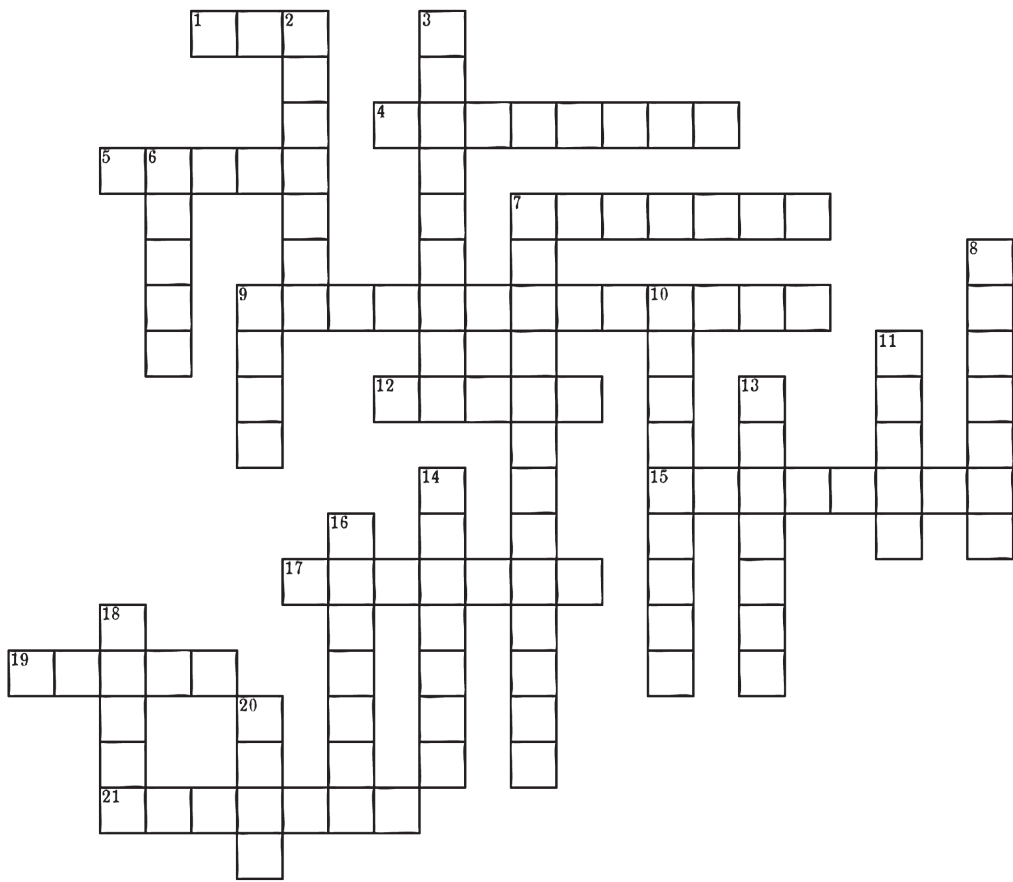


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DE-ROASTING GUN

The CrossRoasts

Complete the crossword below



Across

1. Coffee's final test is found in the....
4. A packed town, or a type of roast
5. Silver skin
7. A professional coffee-tasting session
9. A one-seeded argument
12. The first 30-45 seconds of a hand-pour
15. Arguably the lightest of roasts
17. A type of coffee, and also a type of whiskey
19. Spiky seed pods, or an essential part of your grinder
21. Unwashed, and unloved in some circles

Down

2. You can do this to roasts, and to serial killers, too
3. Another word for body
6. Winnie's preferred processing method
7. The primary gas released by roasted coffee beans
8. A roast flaw, or a specific point in time, beyond return
9. Spent espresso coffee, or a goalie's nightmare
10. The heating method used by the Bullet R1
11. Espresso's cute little hat
13. A wild night on the town, or the perfect 'atmosphere' for espresso
14. This person will make you a coffee drink
16. Not Arabica
18. Yet-to-be-roasted; naive
20. Rhythmic roasting?

For answers, mail : crossword@aillio.com

Does Coffee Cause Cancer? (How Science Gets Twisted)

By the Coffee Drinkers for Common Sense Coalition

You may have heard that in California, coffee must now be served with a cancer warning. For us lovers of the sacred bean, this sounds bad. Really bad. But before you make any rash decisions regarding your daily cup-o-joe, it is a good idea to delve deeper into the science behind the warning.

The suspected carcinogen in coffee that is the cause of all this concern is known as acrylamide, and it is found in many cooked starchy food products, such as potato chips and toast. In the case of coffee, it is formed during the roasting process. Although there is not yet a definitive link between acrylamide and cancer, there is enough evidence to say that it is probably a carcinogen, and so it makes sense to limit our intake.

But as with many other chemicals, it is the dose that makes the poison. Some estimates show that an adult consuming less than 200 meg per day over a long period of time would not expect to see an increase in cancer risk. To put that

in perspective, a slice of toast has about 5 meg of acrylamide. And a cup of coffee contains about 0.9 to 2.5meg per cup. In other words, unless you're drinking a hundred cups of coffee with that morning toast, you're not increasing your risk of cancer.

On the contrary, some studies have shown that coffee drinkers may reap real health benefits. This is because, in addition to acrylamide, coffee contains a great number of other chemicals, including a plethora of antioxidants and phytochemicals. These substances are known to actually reduce the risk of cancer.

So, it appears that the California ruling may be based on bad science and is therefore overly cautious. If you're still worried, it is worth noting that in 2016 the WHO -- the same organization that ruled acrylamide as a probable carcinogen -- actually removed coffee from its list of potential carcinogens.

I, for one, will be drinking my coffee guilt-free, label or no.

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Opinions: Natural vs Washed

In this month's Opinions section, we have asked our guest columnists to take a closer look at the heated debate between natural and washed coffees.

Naturals are Underrated and Unappreciated and Unbelievably Good!

By Niles Nature

Look, we get it. You want the real deal, the pure bean. You crave clarity, clean cups, and consistency. You want to taste the earth the coffee grew up in, and enjoy every bit of nuance lending that particular varietal its unique flavor profile. Why risk fermentation mucking up a good thing?

Let me tell you why. Because natural coffees can taste wonderful. It's as simple as that.

Let me be clear. I have nothing against washed coffees, and in fact, most of the objectively best coffees I have ever tasted have been washed. But there is a special place in my heart for a great natural, and I am finding myself perplexed by those who would argue there is no place for them in the specialty coffee universe.

To those folks I say: Naturals are more than a fad; they are the future! The cup-to-cup consistency may be lacking now, but that is only because we lack knowledge to control the fermentation process

and make it work well for us every time.

And the fact that we know far more about washed coffees than we do natural coffees is certainly no reason to give up on naturals. On the contrary! It's an invitation to learn more. This is a whole new world, begging to be explored. When the know-how is spread far and wide, the risk is reduced and the consistency is dialed in.

And while certainly the fermented flavors of a natural may sometimes obscure some of the flavors present within a fabulous bean, those same fermented flavors can also elegantly harmonize with terroir and varietal notes, or even transform a flat-tasting coffee into something truly special.

For me, the bottom line is the cup. And I've had some amazing cups of natural that have absolutely expanded the range of flavors I can expect from specialty coffee. You're going to have a hard time convincing me, then, that I should turn my back on all those delicious possibilities. I'm no fool.

Washed is the Only Way to Truly Experience a Great Coffee

By Wally Washer

Wanna get on my bad side? Serve me a natural coffee when I asked for a washed. It has happened more

times than I can count and every time I feel like wringing necks. Naturals are getting trendy where I live -- they are a fad that ought to be encouraged to fade for a number of reasons.

The number one reason is simple: flavor. Please understand that I'm not averse to fermented flavors, but I'd much rather taste them in my kimchi than my coffee. In the world of coffee, fermentation is like a bull in a china shop, unwittingly destroying the finely crafted (and imminently delicious) natural works of art that we call coffee beans.

Did I say flavor was the number one reason? Perhaps the number one reason is the damage it may be doing to coffee farmers. They incur tremendous risks by producing a natural to cater to you maladjusted fermentation freaks around the world. What risk could there be, you ask? Well it is very difficult to control that fermentation process, and one misstep can result in an overly-fermented abomination that is essentially unsaleable. And if they can't sell those coffees, who steps in to help the farmer? No one. We are inviting them to gamble with their own livelihood, and that simply isn't fair.

The struggle for better coffee begins and ends with consistency, and we are very far from being able to produce good cups of natural coffee consistently. That's assuming you even believe there are good cups of natural coffee -- to me that's a bit like believing in soy lattes, or Santa Claus.