



A Study On the Possibility of ChatGPT Application for Optimal Coffee Bean Roast Process Development to Focus on The Best Customer Flavor

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Abstract: This paper deals with the possibility of application of LLM (ChatGPT) on the coffee bean roast process. To study the possibility for application of LLM on coffee bean roast process, Firstly, this paper reviews several LLMs on how LLM gives an influence in many areas because its area is so wide such as normal editing works, speak, many advises, and code development by using huge data like coffee flavor. Secondly, this paper reviews several processes of coffee from the seeding to drinking. There are many possibilities in application of AI for coffee process. However, this paper focuses on the roasting process of coffee bean because its impact is so important on coffee flavor. Finally, this study focuses on how to control the effective roast process of coffee bean by ChatGPT. This paper also implements several questions to the ChatGPT (Prompts) to confirm the possibility application of ChatGPT on coffee roast process. The results show the very useful possibility to apply for coffee bean roast process and can have many ideas.

Keywords: Coffee roast, Coffee bean, ChatGPT, LLM, AI automatic control.

I. INTRODUCTION

Currently, as coffee is one of many beverages, many are enjoying, which is a drink of coffee beans obtained through drying, roasting, grinding, and dripping (or boiling). The taste of coffee varies depending on roasting method, dripping style, water-to-coffee ration, water temperature as well as many coffee-producing regions.

Coffee is one of the most interested beverages on the global business market [153, 154]. Therefore, the specialty coffee, scientific sensory evaluation of coffee is increasingly required to understand and meet consumer demands [156]. The sensory quality of coffee is a complex function of all the links in the coffee production chain such as plant agriculture including quality of seed, terroir, drying, roasting, grinding, brewing, and servicing (social, psychological, and situational factors, the final consumer experience [157].

Generally, there are two types of coffee, that is, Robusta and Arabica. As the Arabica coffee was the first found in Ethiopia, the coffee bean has a long and flat. The taste of Arabica coffee has a very variety of different flavors depending the agriculture area and the taste tends to be more acidic. The Robusta coffee beans shows smaller than the Arabica coffee beans and its taste is more bitter style. It also has a higher caffeine content. However, the taste and quality of the coffee beans are affected by the roasting process [151].

In roast process, the process of heat transfer for coffee bean has a key impact on the taste of coffee [148, 149]. The heat of the coffee roasting process is transferred to coffee beans by three methods such as convection, conduction, and radiation [143]. The most important variables of roasting are the type of roaster for heating method, the temperature of the coffee beans for roast level, and the duration of the roasting process [142, 144]. The heat transfer by conduction moves hot air towards coffee beans directly. That is, the heat of the warm surfaces of the rotating drum is transferred through direct contact of the coffee beans. While a drum of roaster rotates, heat conduction distributes from warm heat of drum surface to the surface of the coffee bean.

In coffee bean, because there are many kinds of chemical material and nutrients, roast behavior has an key impact on coffee flavors. That is, Arabica green beans (water \approx 12%; cellulose \approx 50%); protein \approx 10%); mono- and oligo-saccharides \approx 10%; free amino acids \approx 1%; chlorogenic acid \approx 7%); citric, malic, and tartaric \approx 2%) [145, 146]. Therefore, during roast process, these chemical material and nutrients are change or disappear. That is, taste is changed from original bean through the roast process.

As radiation heating is that heat wave penetrates into the coffee bean, if a roaster is not stable a stream by unstable hot gas or the unstable air velocity, the roasting process is be failed [149]. Because of different flavor by roast method, there are many ways suggested [161-167].

A coffee bean roaster generally consists of several parts and the roasting process takes place through these several parts. It is quite important to obtain an optimal roasting process for making the customer-based coffee tastes because the roasting results highly affect the taste and quality of the coffee.

From these chain perspectives, roasting process has a key impact on the quality of coffee. The structure of roaster and operation parameter should be well designed the relation between input of roaster (roaster control parameter) and output (sensory attributes) factors for producing the optimal sensory flavor of the customer from coffee bean.

During coffee bean roasting, volatiles of the green beans are evaporated and non-volatiles are transfer into pyrolysis due to the temperature. The major flavor of coffee is developed by non-enzymatic browning reactions such as the Maillard reaction, caramelization, earthy, roasted, smoky, fruity, and spicy [159]. As the reactions of nonvolatile, there are two kinds. That is, melanoidins from the browning reactions and the fragmentation of chlorogenic acid into quinic acid and caffeic acid. These are the main contribution substance to bitterness of coffee flavor [158].

The roast process, due to the heat stable nature of the molecule, gives an impact on the natural content of caffeine of the green bean and is another source of bitterness of coffee [156]. With a focus on the roasting process, the natural content of aliphatic acids, additionally, carbohydrates are fragmented into smaller aliphatic acids such as formic, acetic, glycolic, and lactic acid [157].

During the roasting process, the beans lose between 15 and 22% of their weight [161]. The roasting process continues for 4 min to 15 min, depending on the roast style [159] or 1–3 min for flash roasting [151]. During the roasting perspective, the effect between roast time and temperature is quite import on volatile formation and the sensory quality of coffee [156]. At least, research should be performed compare the overall impact of roast color and roast time on the sensory flavor of coffee; assess the effect (magnitude and direction) of color on individual sensory attributes; assess the effect (magnitude and direction) of time on individual sensory attributes. About these complicated process and tastes, how we have to roast coffee bean for the customer flavor by AI, especially useful function of current ChatGPT?

II. OVERVIEW OF COFFEE HISTORY

Figure 1 shows the overview of coffee history. However, this history is overview for understanding. Its detailed history is so complicated and this paper does not focus on coffee history or art work but GhatGPT application.

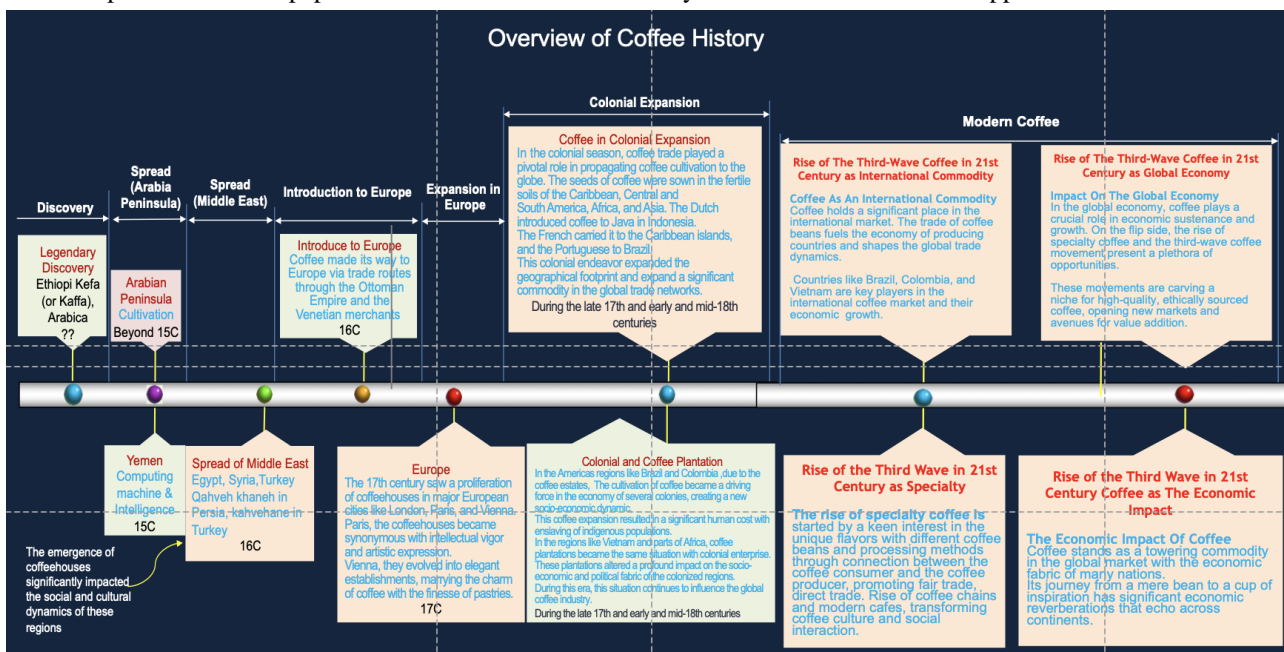


Fig.1. Overview of coffee history.

III. ROAST PROCESSING AND THE CHARACTERISTIC OF COFFEE FLAVOR

A. Roast Impact

The roasting behavior is main process for developing sensory characteristics of coffee such as the roasted coffee flavor, coffee aroma, coffee identity, bitterness, and oily feeling of coffee [140, 143]. During roasting, the volatile and non-volatile chemical compounds produce Maillard, pyrolysis, and Strecker degradation reactions. These sources contribute significantly to the sensory characteristics of the coffee brew [146, 147]. The intensity of these characteristics can vary

depending on the degree of roast attained by the beans. The variation in the volatiles and its species has a very wide variety depending on the degree of roasting [149]. Davide Silva et al. [145] confirmed that dark roasted coffees produce higher intensities compared to medium roasted bean for flavor attributes such as sweet aromatics (a), fermented (a), smoky (f), ashy (f), woody (f), roasted (f), acrid (f), bitter taste, bitter aftertaste, and coffee. They [157] reviewed that the majority of these flavor properties in the dark roasted coffee brews is due to the concentration increase of volatile compounds such as lactones, phenols and chemical compounds produced as a result of degradation of chlorogenic acid. The medium roasted beans show higher intensities for flavor attributes such as cocoa (a) and balanced or blended. Additionally, [157] identified volatile compounds that were most associated with the different degrees of roasting. For example, furfuryl alcohol, and 5-furfural were found in light roasted beans, while 5-furfural, furfuryl alcohol, and gamma-butyrolactone identified with medium roasted beans. Even more, city roasted beans were most differentiated by gamma-butyrolactone, furfuryl alcohol, and 2-acetylpyrrole, whereas the French roasted beans were characterized by the presence of catechol, and gamma-butyrolactone, furfuryl alcohol. The researchers concluded that coffee samples roasted at lower degrees of roasting contained higher concentrations of furanones and furfural derivatives, but the concentrations of pyridines and pyrroles were lower as compared to corresponding samples, and vice versa. Marek Gancarz et al. [147] reported that when under-roasting coffee, an increase in temperature (above 150 °C) consequently increased the intensities of the coffee-like attributes such as burnt and bitter taste and a decrease in the non-coffee-like attributes such as earthy, grassy and nutshell.

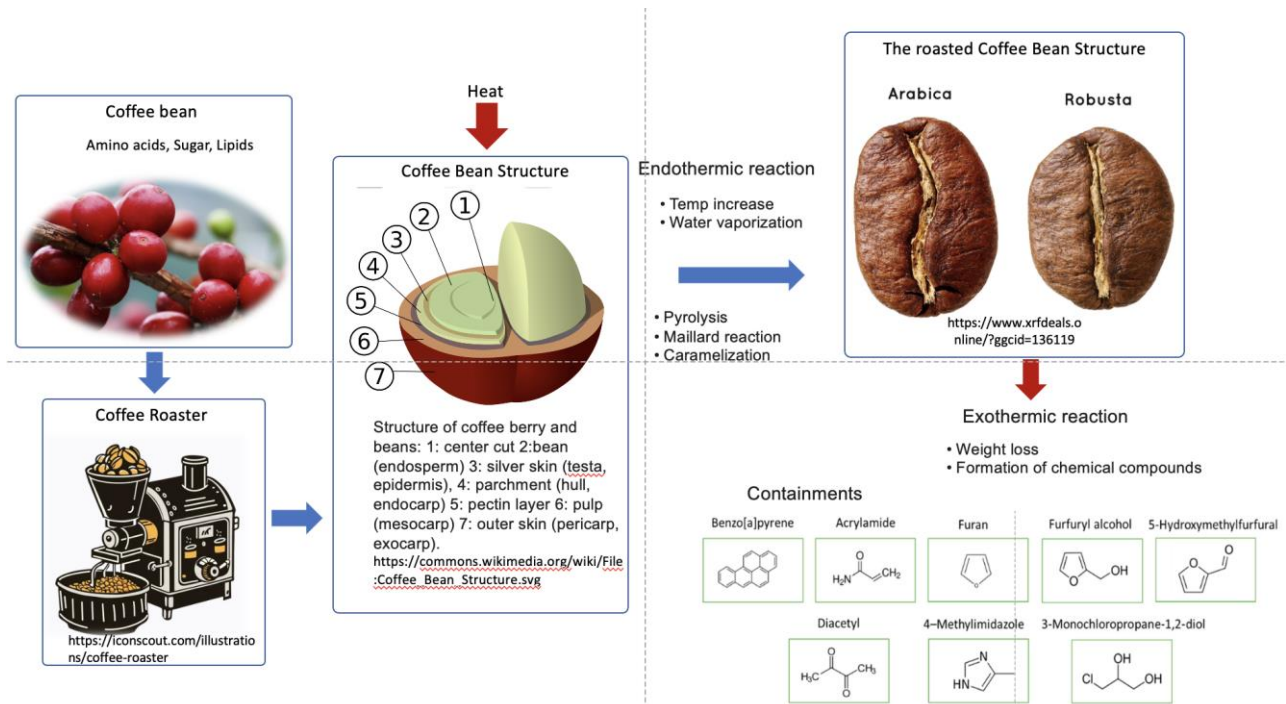


Fig. 2. Roast processing of coffee bean and flavor impact sources.

B. Coffee Types decided by Roasting Level

White Roast Type: After bean is caught by farmer, it should be roasted in the roast machine. Usually, we call as white, medium, and dark. The darker, the less taste at the actual bean because of the quality of bean is slightly lower. When customer want to get the characteristics of coffee bean, they should decide roast level because the majority of the flavor arose from the coffee roasting process.

The white is roasted to 160°C that is before the first crack. The customer cannot taste that they think coffee should flavor coffee. There are two types in the light roast: Cinnamon Style and New England Style.

Cinnamon Style: It is roast temperature when the internal temperature approaches 196°C (385°F), which is a first crack (pop) that expansion by the gas of the bean takes place. At this point, roasting coffee beans sound a bit like popcorn and the bean’s surface is dry and the oil of coffee bean is not fully released. Of course, the beans are quite hard and dense because the gas of bean does not expand to the point that causes the first crack.

New England Style: Roast temperature is just at the point 205°C (401°F) of the first crack of the bean. At this point, the outside of the bean is dry but it is a slightly less dense. However, the flavor is a little more advanced than Cinnamon style. Basically, the taste of light roast bean can be felt with citrus and aromas because almost flavor comes from the

natural characteristics of the coffee bean and roasting process still cannot influence on the flavor. Therefore, the customer can really enjoy the variable taste depending on the grown region. The customer also has an experience on how different climates and environments affect the flavor of coffee. This is the best advantage of light roast.

Medium Roast Type: This roast type can provide the unique flavor of the coffee bean origin, which also causes the aroma of the beans to be much stronger and creates a sweeter flavor. During roast process, the color of coffee bean is changed due to mostly the caramelization of sugars. The temperature of medium process (The internal temperature of coffee bean) is between 210-224°C (410-435°C). The roast process should be finished completely after the first crack activity. In medium type roast, the size of coffee bean is reduced around 13% smaller than the light roast style because of the evaporation of moisture. The taste of the medium roast coffee serves more sweet fruit flavors and roasty flavors such as chocolate, smoke, and nuts. Because the really good balance between sweet fruit the acidity of the bean can provide a really nicely balanced coffee, really good roasting activity depends on the roast skill and the experience. However, which coffee roast is better really come down to customer's personal preferences.

Dark Roast Type: As this roast is process beyond the second crack, the internal temperature of coffee bean is 239-246°C (462-474°F). Because all the oil out to the surface, dark roast coffee provides a bitter-tasting coffee. Usually, there are many cases to hide unpleasant flavors (low quality beans) from growing or processing defects by dark roasting activity. All the original flavors of the beans are removed by dark roasting process. So, customer taste a toasty-burnt flavor that is very low in acidity. The coffee is also distinctly bitter, thick, and slightly smokey. The coffee bean coated with oil in surface carries through into the coffee of the customer. They can feel the oily texture through coffee.

Comparison of Roast Characteristics: If the customer like light, bright, citrusy, and want to feel the region characteristics of the coffee bean (terroir), light roast is better for the customer's flavor. However, the customer prefers the rich flavor and like to feel the unique taste of the region, medium roast is the best way. As beginner, if you want to have an experience, medium roast will be easier because you can move lighter or darker if it is too light or it is too toasty for your taste while you are medium roasting. Basically, there's no right and wrong type of coffee roast because it is just what you love most. There are so many options for roasting process and you can find the best way through roast experiment. The best taste of the coffee bean is varied with wide variety such as packing terms in air-tight bags, exposing level in air or sunlight, roast level, uneven extraction by the water passes through the grounds, and etc.

C. Parameters for Characteristics of Coffee Bean Roast

a) Color Parameters: This is that evaluate roast level using the RGB color of coffee bean roast level. Currently, AI function has a good quality and image analysis is well defined.

b) Texture Parameters

As stage for assessing the quality of roasting coffee beans, after calculating each energy, entropy, homogeneity, and contrast feature, the average calculation is be carried out for each feature used. The results of the average value are used as input data for the classification process.

c) Shape Parameters

This is performed evaluation of form parameter for the quality of coffee roasting. That is, the evaluation is carried out by differentiating the coffee beans of each type (robusta beans, and arabica beans) and distinguishing good and defective coffee beans. The feature evaluation contains the shape parameter, area, circumference, diameter, and roundness percentage. The feature area is obtained by counting the number of pixels with a value of one.

D) Relative Impact of Roast Color and Timing on Coffee Flavor

Depending on recognition of the specialty coffee is increasing, , there is an accelerated interest in modulating roast profiles to present customers with new and diverse sensory experiences. The present study investigates the chemical and sensory effects of subtle variations in the 'development time' phase of the coffee roasting process. Four roast profiles were studied through sensory descriptive analysis (DA), gas chromatography–mass spectrometry (GC–MS), and nuclear magnetic resonance (NMR). Multivariate analysis showed clear separation of DA, GC–MS, and NMR data. The current research suggests that a short development time increases the fruity, sweet and acidic characteristics of the coffee and a longer development time shifts the balance towards a more roasty, nutty, and bitter profile. These results provide a good roast information for the effect of roast profiles.

E) Impact of Timing Variation and Roasting Phase

According to information, fast roasting offers a higher sensory flavor of Fruitiness, Sweetness and Acidity due to a chemical composition. However, longer development times provide a more Roasted, Nutty and Chocolate, and Bitter sensory perception because of a change in the chemical profile. The flavor diversity of the specialty coffee is decided by time dependent quality control.

F) Cupping of roasted coffee beans

It is a simple technique carried out as a way of comparing and contrasting different coffees, it's also used to test quality, check for defects, and determine suitability for blends by professionals and enthusiasts. Cupping is an important process to decide high-quality coffee. As Cupping was established in the late 1800s by coffee merchants, it is an important method of evaluating coffees that has been in use across the coffee industry for more than one hundred years.

However, the Specialty Coffee Association of America (SCAA) developed a cupping protocol, which remains the worldwide industry standard today, it was adopted as a way of judging and evaluating coffees in Cup of Excellence competitions. The idea of cupping is to decide qualities such as body, mouthfeel, acidity, sweetness, and aftertaste. An experienced cup taste can determine specific flavor notes, such as redcurrant, chocolate, and caramel, as well as pinpointing the origin of the coffee.

G) Bioactive compounds quantification

In recent years, the beverage market has become increasingly diversified due to attention to the health-promoting effects of the consumer demand. That is, as the brewing method is the main contributing factor for the coffee beverage chemical-nutritional composition, research should be performed how bioactive compound content (polyphenols, antioxidants, and BAs) depending on the brew preparation. The overall reduction of bioactive compounds in coffee beverages could probably be due to the high brewing temperatures and pressures, which lead to the degradation of these compounds. The water-coffee contact surface and the particle size of the coffee powder may affect the extractant capacity of biogenic amines and phenolic compounds [1, 5].

H) Determination of acrylamide concentration

Acrylamide is potentially human health hazard material as a heat-generated food toxicant. In coffee roast processing, this chemical acrylamide is formed during the early roasting stages of coffee bean but when the roasting time increase the concentration of acrylamide decrease. The acrylamide levels decrease with lower concentrations of asparagine and with increasing temperature and time of roasting. Depending on roast level, coffee bean contains different acrylamide level. The level of this amino acid becomes relevant when considering immature beans due to the high concentration in these. The depulping of green coffee fruits enables a reduction in the levels of asparagine.

IV. OVERVIEW OF CHATGPT FOR APPLICATION OF COFFEE BEAN ROAST

The function of LLM (ChatGPT) provides to cover all over the world and every area, such as industry, art, movie product, story-telling, after unveiled ChatGP 4.0 in March 2023 following ChatGPT 3.5 in Nov. 2022.

This ChatGPT released by OpenAI is changing technology paradigm and social, and giving an impact on everything and everywhere in our community and business. The basic theory of this technology is not so difficult and it impact on everywhere. Therefore, so many companies and countries are interested in developing or how to use this related technology.

This LLM (ChatGPT: Chat Generative Pretrained Transformer AI) technology has learning system (supervised learning, unsupervised learning, and reinforcement learning to train language) as basic learning and they combine for the situation effectively learning. The ChatGPT models are also not difficult to understand technology but its impact is a very huge and is changing social as well as the paradigm of research and coding.

The generative AI model based LLM (Large Language Model), TIM (Text-to-Image Model), and ITM (Image-to-Text Model) are rapidly increasing for applying in everywhere because a new generation of user-friendly tool (Generative AI: Chat GPT) is useful for texts, images, and videos.

Of course, economic effect of generative AI is quite huge such as automation by generative AI, heighten labor productivity by generative AI, higher education, and higher wages occupations (McKinsey, in June 2023). A new revolutionary paradigm of generative model will mainly impact on leading economic growth with the new content, LLM based collaboration swells, lifelong learning for old ages, and several tasks because its impact is wide and more profoundly in tasks such as storytelling writers, translators, customer servers, marketing, legal professionals, document analyzer and makers, graphic designers, architects, artists, image generators, educator, students, and visual contents.

The first aim of his paper is to provide study strategies on how generative model and related technologies apply to coffee roast processing and what we have to prepare and study. It is very important to understand and decide on how and what we have to do coffee process and roast process.

A. The Status of LLMs

This AI technology has a very strong trigger role to develop new AI and has initiative in AI areas. There are several LLM (ChatGPT) and related LLM after releasing GhatGPT 3.5 and 4.0 for ChatGPT5o based technology. That is, many ChatGPT-based applications are developing it is changing for our economic growing pattern and job changing. This paper provides current patterns for ChatGPT technologies and its application for coffee roast process.

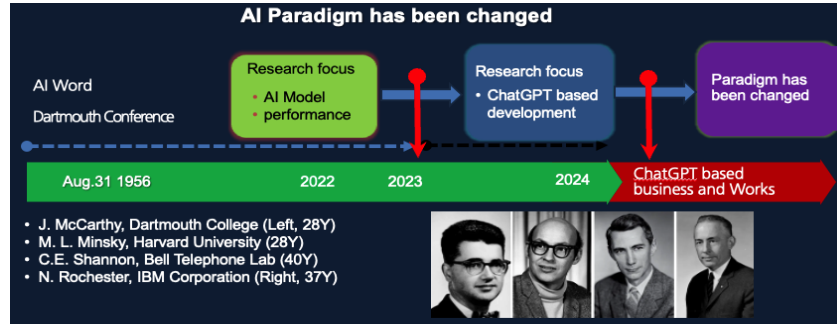


Fig. 3. Timeline of AI paradigm from 1956.

The 10 Biggest AI trends		The best ChatGPT Tool (2024.3.24)	
1. Generative AI		1. ClickUp	9. Bing AI
2. AI-ML Democratization		2. Writesonic	10. OpenAI Playground
3. Big on AI and Human Collab		3. Copy.ai	11. Perplexity AI
4. Digital Twins		4. SpinBot	12. Claude
5. Low-code or No-code AI Optimization		5. Jasper Chat	13. Vertex AI
6. AI and Augmented Analytics		6. Bard AI	14. Microsoft Copilot
7. AI in Cyberspace		7. YouChat	15. Mutable AI
8. AI Ethics		8. Otter	
9. Advent of Edge AI			
10. AI and Quantum Computing			

Generative AI ranking, March, 2024		The 20 ChatGPT Users Ranking (March.2024)	
1. ChatGPT	11. IIEleventLabs	1. ChatGPT	11. IIEleventLabs
2. Gemini	12. HuggingFace	2. Gemini	12. HuggingFace
3. Character.ai	13. Leonardo.AI	3. Character.ai	13. Leonardo.AI
4. Liner(Korea)	14. Midjourney	4. Liner	14. Midjourney
5. QuillBot	15. SpicyChat	5. QuillBot	15. SpicyChat
6. Poe(No working)	16. Gamma	6. Poe	16. Gamma
7. Perplexity	17. Crushon AI	7. Perplexity	17. Crushon AI
8. JanitorAI	18. cutout.Pro	8. JanitorAI	18. Cutout.pro
9. CIVITAI	19. PIXLR	9. CIVITAI	19. PIXLR
10. Claude	20. VEED.IO	10. Claude	20. VEED.IO

Fig. 4. LLM (ChatGPT) status [132, 133, 134].

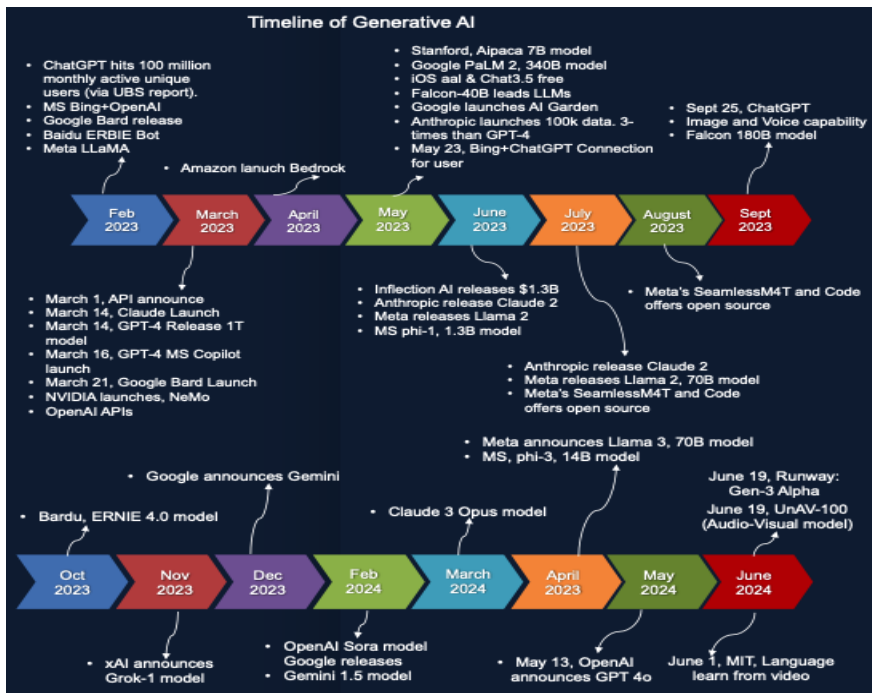


Fig. 5. Current development history of ChatGPT

Social Patterns Leading of LLMs based Techniques: Many companies are developing generative AI for application models (Appl) as well as basic models, related technologies, and coding methods after releasing of OpenAI. The results impact on social areas as shown in Fig. 6. Its applications influence the marketing, art, industries, medical, and biotech as well as prediction and simple application, translation using GAN, transformer functions, and variational auto-encoders. The LLM combines with robots and its results have much more impact on education patterns.

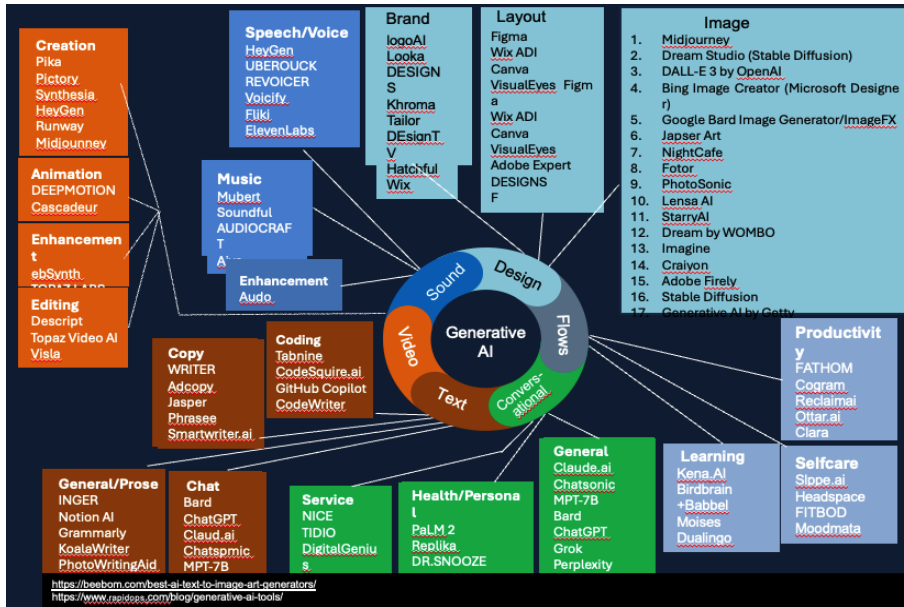


Fig. 6. Comparison MS, Google, and Meta of ChatGPT.

Major investments by Top 5 companies: Ref. [131] shows the market size of LLMs. Apple’s stock price increased by 36% in 2023. The company’s growth was largely driven by solid earnings for a consumer slowdown. Microsoft’s stock price rose by 37% in 2023. The company’s growth was supercharged by the excitement over generative AI, a technology to which Microsoft has close ties. Alphabet, the parent company of Google, saw its stock price increase by 39% in 2023. Like Microsoft, Alphabet’s growth was fueled by the hype around generative AI. Amazon’s stock price grew by 44% in 2023. The company’s growth was largely driven by remarkably solid earnings that defied earlier expectations for a consumer slowdown. Nvidia, a leader in AI and graphics processing units, saw a massive surge in its stock price by 159% in 2023. The company’s growth was driven by the excitement over AI-related advancements.

Job Patterns: The potential benefits of the generative AI are to transform technology by using confusion and speed up to developing terms. Generative AI also can easily estimate productivity growth using wide and huge data. It will give an impact on widespread adoption and add trillions of dollars a year to global economic output (WJS).

Fig. 7 shows on how impact will give areas by generative AI by summarized author based on [135]. LLM-based economic patterns is changing so fast and millions of employees at labor jobs including higher jobs have been decreasing by LLM based robots. It means so-called knowledge workers and white-collar professionals such as designer, art producer, movie producer, story teller writer, project manager, and so on. will be impacted more pain because of these fusion technologies based on generative AI.

Applications of generative AI ready to penetrate into business and many startups of generative AI based business is developing business system as well as generators for text, computer code, images, video, design, voice and music. Illustrators, healthcare workers, actors, educators, legal researchers, office workers and drug-company technicians could be the first occupations threatened with this new form of this AI.

As Fig. 7 is results reported by Mckinsey, the impact of generative AI by business functions do vary but the report notes very compelling specific examples: Generative AI could increase sales productivity by 3-5% of current global sales expenditures. Across 63 use cases, generative AI has the potential to generate \$2.6 trillion to \$4.4 trillion in value across industries.

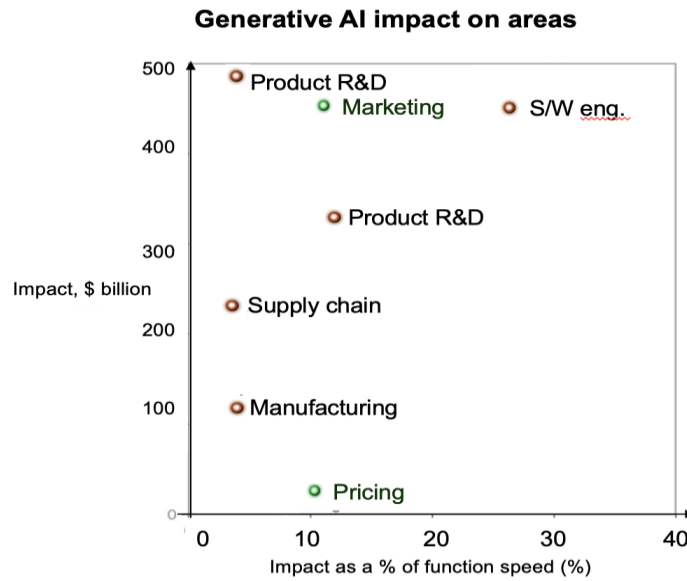


Fig. 7. Generative AI impact on each area [135].

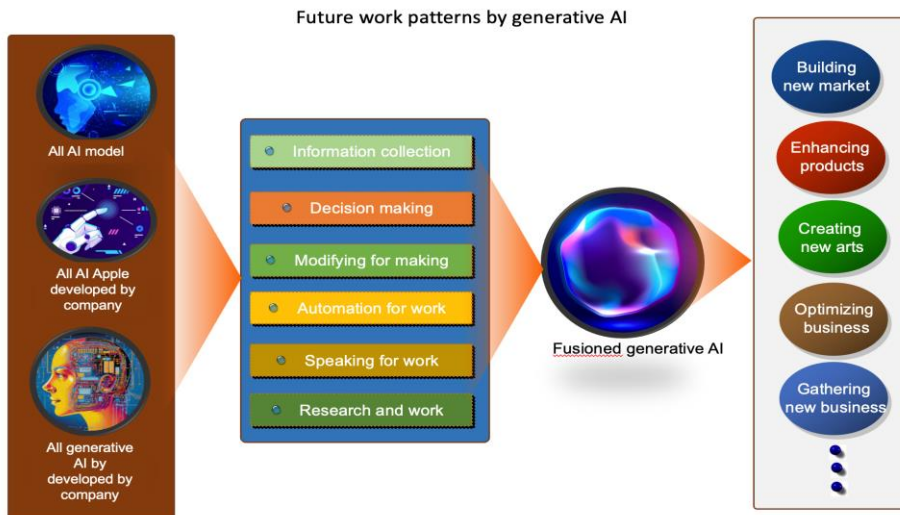


Fig. 8. Future impact by LLM.

V. AI AND CHATGPT BASED OPTIMAL CONTROL OF COFFEE BEAN ROAST PROCESS FOR THE BEST FLAVOR OF CUSTOMER

Fig. 9 shows the simulation block diagram for coffee bean roast process. In Fig. 9, data is data source that can influence the flavor of coffee during bean roast process. This data source is opened in many papers and articles. These data should got and rearranged to use AI. Of course, if we use only ChatGPT, we do not need worry about data but we have to prepare to prove the effectiveness of chatGPT.

Neural network block shows the AI block to obtain an optimal result. Depending on situation of roast process, weight function, the number of input and output should be design. Flavor test (chemical data measured by online during roasting) and sensory flavor by human should be feedback to decide the exact flavor.

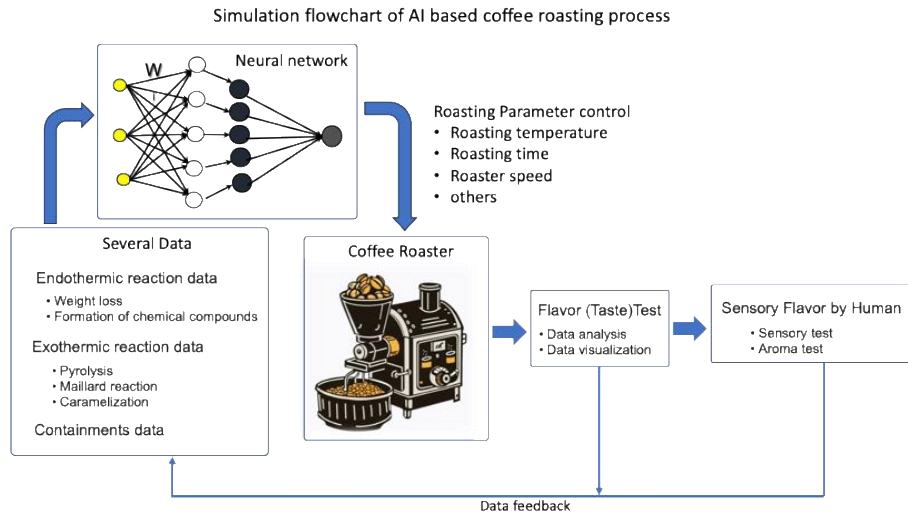
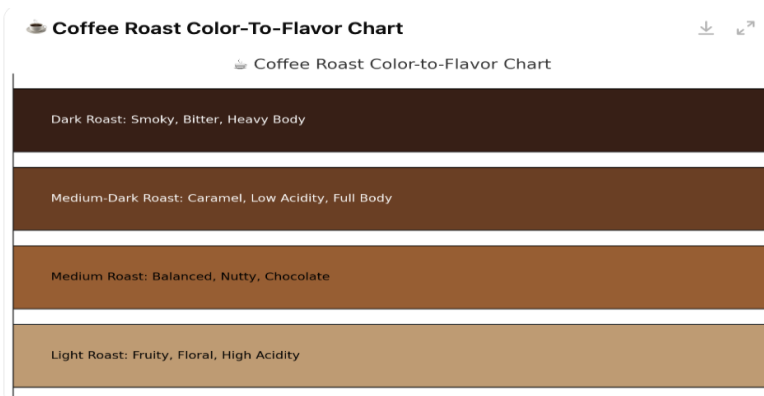


Fig. 9. Simulation flowchart of AI based coffee bean roast process.

VI. ChatGPT IMPLEMENTATION

A. Show the Color Parameters of Bean Roast

ChatGPT response:



Here is a visual color-to-flavor chart showing how different coffee roast levels impact flavor:

- **Light Roast:** Fruity, floral, high acidity – ideal for pour-over or single origin tasting
- **Medium Roast:** Balanced, nutty, chocolatey – great for most brewing methods
- **Medium-Dark Roast:** Caramel, full body, lower acidity – rich and bold
- **Dark Roast:** Smoky, bitter, heavy body – perfect for espresso and milk-based drinks

B. Texture Parameters for the best flavor by ChatGPT

ChatGPT response: The image shows a list titled "Texture Parameters for the Best Flavor" with the following points:

- Crispy – light, brittle, and makes a sharp sound when broken or bitten.
- Crunchy – more substantial than crispy; louder and more sustained when chewed.
- Tender – soft, easy to cut or chew, often juicy.
- Juicy – releases liquid when bitten or chewed.
- Moist – slightly wet or not dry, usually pleasant and flavorful.
- Flaky – breaks into thin layers or pieces.

- Creamy – smooth and rich, often associated with dairy or fat-based textures.
- Smooth – even texture, no lumps or graininess.

ChatGPT also shows shape parameter with table.

 **Texture Parameters**

Parameter	Description
Crispy	Light, brittle, and makes a sharp sound when broken or bitten.
Crunchy	More substantial than crispy; louder and more sustained when chewed.
Tender	Soft, easy to cut or chew, often juicy.
Juicy	Releases liquid when bitten or chewed.
Moist	Slightly wet or not dry, usually pleasant and flavorful.
Flaky	Breaks into thin layers or pieces.
Creamy	Smooth and rich, often associated with dairy or fat-based textures.
Smooth	Even texture, no lumps or graininess.

 **Shape Parameters of Coffee Beans**

Parameter	Description
Roundness	Uniform, symmetrical shape contributes to even roasting.
Size	Larger beans may have more nuanced flavor; size affects roast time.
Uniformity	Consistent size and shape help ensure even flavor development.
Plumpness	Full, well-developed beans often indicate maturity and richness.
Surface Texture	Smooth surface usually means proper processing and quality.
Groove Depth	The center cut (or crease) depth can indicate bean density.
Symmetry	Balanced bean shape affects rotation and heat exposure during roasting.

C. Impact of Roast Color and Timing on Coffee Flavor

ChatGPT Response:

The image titled "Relative Impact of Roast Color and Timing on Coffee Flavor" presents a figure explaining how roast color and roast timing affect the resulting flavor of coffee.

Here's a breakdown of the key ideas shown in the figure:

Roast Color (Light → Dark)

- Light Roast
 - Higher acidity
 - More origin character (fruity, floral, citrus notes)
 - Less body
- Medium Roast
 - Balanced flavor
 - Moderate acidity and body
 - Toasty, chocolatey tones
- Dark Roast
 - Low acidity

- Dominant roast flavor (smoky, bitter, charred)
- More body, less origin character

Roast Timing (Fast → Slow)**- Fast Roast (Short Development Time)**

- Bright, acidic flavors dominate
- Less caramelization and complexity
- May highlight undesirable sharpness if not controlled

- Slow Roast (Long Development Time)

- Rich, mellow flavors
- More sweetness and complexity due to Maillard reactions
- May mute some high notes (acidity and fruitiness)

D. Relative Impact

The chart shows how both roast color and timing interact to define the flavor outcome:

- Light roast with fast timing = *sharp, acidic, vibrant*
- Medium roast with slow timing = *balanced, sweet, complex*
- Dark roast with fast timing = *bold, possibly burnt*
- Dark roast with slow timing = *rich, smoky, lower acidity*

E. Explain Impact of Timing Variation and Roasting Phase**ChatGPT Response:**

The image you've uploaded contains a chart showing different phases of coffee roasting and how timing variations can impact the final roast. Here's an explanation of both the Impact of Timing Variation and the Roasting Phases:

Roasting Phases Overview

- Drying Phase (Yellowing Stage)
 - Start: From green to yellow beans.
 - Purpose: Evaporates moisture from the bean.
 - Typical Duration: ~4-6 minutes.
 - Impact: Too short can cause uneven roast; too long may result in baked flavors.
- Maillard Reaction Phase
 - Start: Begins as beans yellow; ends just before first crack.
 - Purpose: Where browning occurs – responsible for flavor and aroma development.
 - Typical Duration: ~3-5 minutes.
 - Impact: Key phase for flavor complexity. Too fast = underdeveloped; too slow = flat taste.
- Development Phase (First Crack to End of Roast)
 - Start: Begins at first crack.
 - Purpose: Finalize flavor, control acidity/body.
 - Typical Duration: Varies depending on roast goal.
 - Impact: Crucial for final flavor. Longer = more sweetness/body; shorter = brighter acidity.

Impact of Timing Variation

- Short Drying Phase:

- Insufficient drying → uneven roast → grassy taste.

- Long Maillard Phase:

- Enhances sweetness and complexity but risks flatness if overdone.

- Short Development Time:

- Bright, acidic cup but may taste sour or underdeveloped.

- Long Development Time:

- Sweet, chocolatey, or roasty flavors; risk of bitterness or dullness if overextended.

Ideal Timing Strategy

A balanced roast often follows this rule of thumb:

- Drying Phase: ~30-40% of total roast time.
- Maillard Reaction: ~30%.
- Development Phase: ~20-25%.

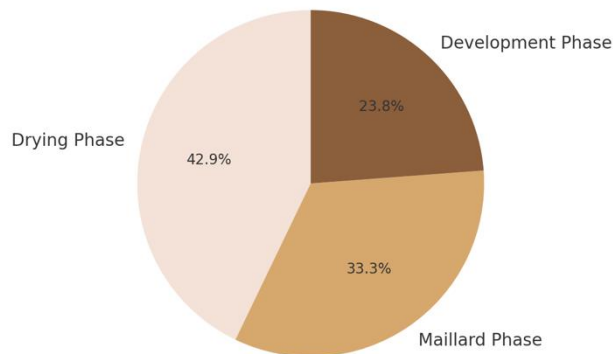
But this can shift depending on roast goals (e.g., light vs dark roast).

Show with figure

ChatGPT Response:

Roast Profile Phases by Time Percentage

Roast Profile Phases by Time Percentage



Here's a visual breakdown of a sample roast profile showing the time spent in each phase:

- Drying Phase (42.9%) – Ends around 4.5 minutes. Focused on removing moisture.
- Maillard Phase (33.3%) – From 4.5 to 8.0 minutes. Crucial for developing sweetness and complexity.
- Development Phase (23.8%) – From first crack (8.0 min) to drop (10.5 min). Final flavor shaping.

If you'd like, I can show how different phase adjustments affect the outcome or simulate a specific roast style (light/medium/dark). Want to tweak this

F. Explain Cupping of roasted coffee beans

ChatGPT Response:

The image you've uploaded outlines the cupping process of roasted coffee beans—a standardized method used to evaluate coffee's aroma, flavor, and overall quality. Here's a breakdown of the cupping steps typically followed:

Steps in Coffee Cupping

- Weigh and Grind Beans
- Use 8.25g–12g of freshly roasted coffee per cup (usually 150–200ml).
- Grind to a medium-coarse consistency—similar to coarse sand.
- Place grounds into the cupping bowl or cup.
- Smell the Dry Grounds
- Evaluate the dry aroma. Note fragrances like floral, nutty, chocolatey, etc.
- Add Water
- Pour hot water (around 93–96°C / 200–205°F) directly over the grounds.
- Fill the cup completely and start a timer.
- Steep and Observe the “Crust”
- Let it steep for 4 minutes.
- A crust of coffee grounds will form on the surface.
- Break the Crust
- At the 4-minute mark, use a spoon to gently push the crust back while inhaling deeply.
- This is when you get the wet aroma.
- Skim the Grounds
- After breaking the crust, skim off any floating grounds or foam.
- Taste the Coffee
- Let it cool a bit (usually to around 60–70°C).
- Slurp strongly from a spoon to spray coffee across your palate.
- Evaluate flavor, acidity, body, sweetness, aftertaste, and balance.
- Record Notes
- Use a cupping form or score sheet to document your impressions.

What You’re Evaluating:

- Fragrance/Aroma: Dry vs wet
- Flavor: Overall impression
- Aftertaste: Lingering notes
- Acidity: Brightness or liveliness
- Body: Texture or mouthfeel
- Sweetness: Natural sugar perception
- Balance: Harmony of the above attributes
- Clean Cup: Clarity of flavor
- Uniformity & Defects: Consistency and flaws across cups

Let me know if you want a cupping form template, a flavor wheel, or help comparing multiple coffees. Happy slurping!

I want a cupping form template, a flavor wheel, or help comparing multiple coffees.

ChatGPT Response:

Great! Let's get you started with all three:

Cupping Form Template (SCA-style Inspired)

Attribute	Score (0–10)	Notes
Fragrance/Aroma		Dry and wet aroma impressions
Flavor		Initial taste impressions
Aftertaste		Lingering flavors
Acidity		Brightness & liveliness
Body		Mouthfeel/texture
Sweetness		Natural sugar perception
Balance		How well elements blend
Clean Cup		Free of off-flavors
Overall Score		Personal impression

Total Score: /100

Want it as a downloadable PDF or editable spreadsheet?

Coffee Flavor Wheel

The flavor wheel helps identify specific notes during cupping. It's usually broken down into categories:

Main Categories:

- Fruity – Berry, Citrus, Dried Fruit, Tropical
- Floral – Black tea, Rose, Jasmine
- Sweet – Brown sugar, Caramel, Honey
- Nutty/Cocoa – Almond, Hazelnut, Chocolate
- Spices – Cinnamon, Clove, Nutmeg
- Sour/Fermented – Vinegar, Winey, Yeast
- Other – Earthy, Woody, Papery, Chemical (defects)

Want me to generate a colorful digital flavor wheel image for you?

Comparing Multiple Coffees

You can compare 2 or more coffees side-by-side using a table like this:

Attribute	Coffee A (Kenya)	Coffee B (Ethiopia)	Coffee C (Brazil)
Aroma	8.5 (fruity)	9.0 (floral)	7.0 (nutty)
Flavor	8.0	9.2	7.5
Acidity	8.8	9.5	6.5
Body	7.5	7.0	8.8
Sweetness	8.3	8.8	7.9
Overall Score	85	90	82

Just tell me what format you'd like these in:

- PDF or Excel for the cupping form
- High-res image of the flavor wheel
- Custom comparison table for specific origins?

G. Explain Bioactive compounds quantification

ChatGPT Response:

The image you've uploaded seems to reference quantification of bioactive compounds—a key part of analyzing the health-related properties and quality of coffee (or other food products). Here's an explanation tailored to roasted coffee:

Quantification of Bioactive Compounds in Coffee

Bioactive compounds are naturally occurring chemical compounds that have biological effects on humans. In coffee, several important ones are analyzed for both health benefits and quality assessment.

Common Bioactive Compounds in Roasted Coffee

- Caffeine
 - Effect: Central nervous system stimulant.
 - Quantification: HPLC (High-Performance Liquid Chromatography) is commonly used.
- Chlorogenic Acids (CGAs)
 - Effect: Antioxidant, contributes to acidity and flavor.
 - Quantification: Measured via HPLC or LC-MS/MS.
 - Note: Levels decrease with darker roasting.
- Trigonelline
 - Effect: Precursor of niacin (vitamin B3), contributes to flavor.
 - Quantification: UV spectrophotometry or HPLC.
 - Note: Degrades with heat, producing aroma compounds.
- Melanoidins
 - Effect: Antioxidant and anti-inflammatory.
 - Quantification: Spectrophotometry; formed via Maillard reaction during roasting.
- Diterpenes (Cafestol, Kahweol)
 - Effect: May raise cholesterol; also have anti-inflammatory effects.
 - Quantification: GC-MS or HPLC.

Analytical Methods Used

Method	Purpose
HPLC	Separates and quantifies caffeine, CGAs
LC-MS/MS	High sensitivity for chlorogenic acids
UV-Vis Spectrophotometry	Quick screening of antioxidant levels
GC-MS	Analyzes volatile and semi-volatile compounds
FTIR Spectroscopy	Fingerprinting of compound structures

Example: Caffeine Quantification via HPLC

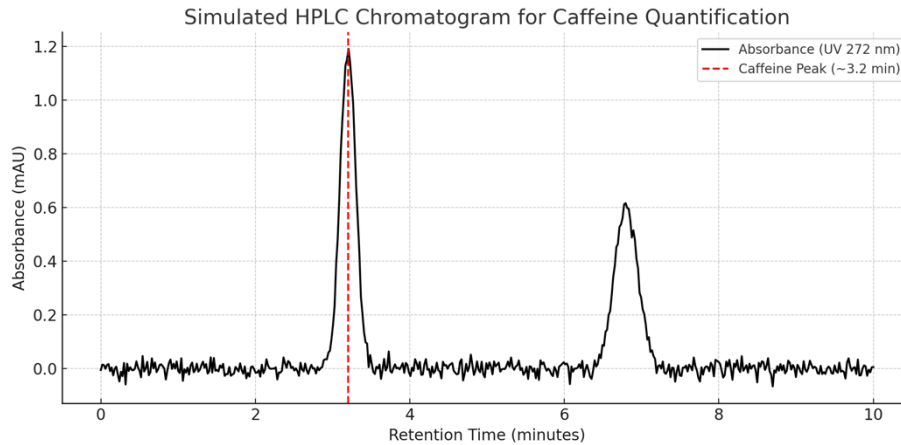
- Sample prep: Brew or extract coffee → filter → dilute.
- Injection: 10–20 µL into HPLC.
- Detection: UV at 272 nm (typical for caffeine).
- Output: Peak area compared with caffeine standard curve → get mg/mL or mg/g.

Would you like a visual of how HPLC quantifies caffeine or a template lab report for quantifying any of these compounds?

show visual of how HPLC quantifies caffeine or a template lab report for quantifying any of these compounds?

ChatGPT Response:

Simulated HPLC Chromatogram for Caffeine Quantification



Here's a visual of how HPLC quantifies caffeine:

- The x-axis shows retention time (in minutes), which is how long it takes compounds to pass through the HPLC column.
- The y-axis shows absorbance at 272 nm, the wavelength where caffeine strongly absorbs UV light.
- The sharp peak at ~3.2 minutes represents caffeine.
- The peak area is proportional to the amount of caffeine in your sample and is compared to a standard curve to calculate concentration.

Want a Lab Report Template?

Let me know your format preference:

- Word document (.docx)?
- PDF?
- Google Docs?

I can include:

- Objective
- Materials & Methods
- HPLC setup
- Data (table & chromatogram)
- Results with example calculations

Want the full template now?

Title: Quantification of Caffeine in Coffee Using HPLC

Objective: To quantify the caffeine content in roasted coffee samples using High-Performance Liquid Chromatography (HPLC).

Materials and Equipment:

- Roasted coffee sample
- HPLC system with UV detector (set to 272 nm)
- Caffeine standard solutions (0.1 to 1.0 mg/mL)

- Mobile phase: Acetonitrile:Water (20:80 v/v) with 0.1% formic acid
- HPLC-grade solvents
- Syringe filters (0.45 µm)
- Volumetric flasks, pipettes, beakers

Methodology:

- **Sample Preparation:**

- .1) Brew coffee (e.g., 10 g in 100 mL water).
- .2) Cool and filter through 0.45 µm syringe filter.
- .3) Dilute appropriately with mobile phase.

- **Standard Preparation:**

- .1) Prepare caffeine standards ranging from 0.1 to 1.0 mg/mL.

- **HPLC Conditions:**

- .1) Column: C18, 250 mm x 4.6 mm, 5 µm
- .2) Mobile Phase: Acetonitrile:Water (20:80 v/v) with 0.1% formic acid
- .3) Flow Rate: 1.0 mL/min
- .4) Detection Wavelength: 272 nm
- .5) Injection Volume: 20 µL
- .6) Run Time: 10 minutes

- **Data Acquisition:**

- .1) Inject standards and samples.
- .2) Record retention time and peak area.

- **Quantification:**

- .1) Plot a calibration curve (peak area vs. concentration).
- .2) Use linear regression to derive the caffeine concentration in sample.

Results:

Sample ID	Retention Time (min)	Peak Area	Caffeine Conc. (mg/mL)
Sample 1	3.21	25500	0.52
Sample 2	3.20	24800	0.50

Calibration Curve Equation: $y = 48500x + 1200$ ($R^2 = 0.998$)

Discussion:

- The caffeine peak appeared consistently at ~3.2 min.
- Linear calibration confirmed with $R^2 = 0.998$.
- Samples contained ~0.50 mg/mL caffeine after brewing.

Conclusion: HPLC is an effective and reliable method for quantifying caffeine content in roasted coffee.

References:

- ① AOAC Official Method 986.13
- ② International Coffee Organization analytical guidelines

H. Explain Determination of acrylamide concentration**ChatGPT Response:**

The image describes a flowchart for the Determination of Acrylamide Concentration, likely from a food or chemical analysis context. Here's a breakdown of the steps shown:

1. Sample Preparation

- Weigh 5g of the sample (could be a food or other test material).
- Add 10 mL water.
- Shake for 10 minutes.

2. Centrifugation

- Centrifuge the mixture at 4,000 rpm for 10 minutes.
- Collect the supernatant (liquid on top).

3. Cleanup

- ① Add Carrez I and II solutions (used to precipitate proteins and other impurities).
- ② Shake and then centrifuge again.
- ③ Filter the resulting liquid.

4. Extraction

- Use Solid Phase Extraction (SPE):

- Condition the SPE cartridge.
- Load the sample.
- Wash and then elute acrylamide with appropriate solvents.

5. Analysis

- The cleaned extract is analyzed using LC-MS/MS (Liquid Chromatography with Tandem Mass Spectrometry), a highly sensitive and specific technique ideal for acrylamide detection.

This procedure is typical in analytical chemistry labs aiming to quantify acrylamide in food products, especially in items like coffee, potato chips, or baked goods where acrylamide formation is a concern.

Would you like help turning this into a lab report or summarizing it for a presentation?

I like to turn about coffee into a lab report or summarizing it for a presentation?

ChatGPT Response:

Nice! Since we're talking about acrylamide in coffee, let's tailor both the lab report and presentation summary specifically for that context. Acrylamide is a compound that can form during roasting, so coffee analysis is a common application.

Lab Report: Determination of Acrylamide Concentration in Coffee

Objective

To quantify the concentration of acrylamide in roasted coffee using a combination of solid-phase extraction and LC-MS/MS analysis.

Background

Acrylamide is a potentially harmful compound formed during high-temperature processing of foods, particularly in carbohydrate-rich products like coffee. Monitoring its levels is crucial for food safety and regulatory compliance.

Materials and Reagents

- Ground roasted coffee (5 g)
- Distilled water (10 mL)
- Carrez I and II solutions (for protein precipitation)
- Solid Phase Extraction (SPE) cartridge
- Centrifuge
- Filter paper and funnel
- LC-MS/MS instrument
- Acrylamide standard solution (for calibration)

Procedure

1. Sample Extraction

- Weigh 5 g of ground roasted coffee into a beaker.
- Add 10 mL of distilled water.
- Shake the mixture for 10 minutes to extract acrylamide.

2. First Centrifugation

- Centrifuge the mixture at 4,000 rpm for 10 minutes.
- Carefully collect the supernatant.

3. Protein Precipitation and Cleanup

- Add Carrez I and II solutions to the supernatant (typically 0.5 mL each).
- Shake briefly, then centrifuge again to remove precipitates.
- Filter the liquid using standard filter paper.

4. Solid Phase Extraction (SPE)

- Condition the SPE cartridge.
- Load the filtered extract onto the cartridge.
- Wash with appropriate solvent to remove matrix components.
- Elute acrylamide using a clean solvent (e.g., methanol or water-methanol mix).

5. Analysis by LC-MS/MS

- Inject the cleaned extract into the LC-MS/MS system.
- Compare results to a standard calibration curve to determine acrylamide concentration.

Results

(Placeholder: "Acrylamide concentrations ranged from X to Y µg/kg depending on roast level.")

Conclusion

The method effectively isolates and quantifies acrylamide in roasted coffee. Lighter roasts tend to have higher acrylamide levels, while darker roasts may show reduced concentrations due to thermal degradation.

Presentation Summary: Acrylamide in Coffee

Slide 1: Title Acrylamide in Roasted Coffee: Detection & Quantification

Slide 2: Why It Matters

- Acrylamide is formed during coffee roasting.



- Linked to potential health risks.
- Regulated by food safety authorities.

Slide 3: Objective

- Measure acrylamide in coffee using LC-MS/MS.

Slide 4: Workflow Overview

- Sample extraction
- Centrifugation
- Cleanup (Carrez I & II)
- Solid Phase Extraction
- LC-MS/MS analysis

Slide 5: Sample Prep

- 5g coffee + 10mL water
- Shake 10 mins
- Centrifuge 4000 rpm

Slide 6: Cleanup

- Add Carrez reagents
- Centrifuge again
- Filter

Slide 7: Extraction & Analysis

- SPE cartridge for acrylamide isolation
- LC-MS/MS for quantification

Slide 8: Results

- (Insert graph or table of acrylamide vs roast level)

Slide 9: Conclusion

- Effective method
- Acrylamide decreases with darker roasting

Would you like a ready-to-use PowerPoint, Word doc, or both? I can generate and export them for you.

I like a ready-to-use power point

ChatGP Response:

Your ready-to-use PowerPoint presentation on "Acrylamide in Roasted Coffee" is now complete!

[🔗 Click here to download it](#)

Let me know if you'd like to add charts, visuals, or customize the style!

I like to add charts, visual, graph, customize the style




ChatGP Response:

Awesome! We can definitely enhance the presentation with visuals, custom styles, and charts. Here's a plan for the upgrades—let me know what you'd like from each, or if you want it all:

Suggested Enhancements




1. Charts & Graphs

We can add:




-  Bar graph: Acrylamide concentration vs. roast level (light, medium, dark)
-  Pie chart: Relative percentage of acrylamide levels by roast type
-  Line chart: Acrylamide degradation over roasting time

You can give me real or sample data, or I can use realistic estimates.

2. Visuals

-  Photos or icons of coffee beans, roasting process, LC-MS/MS equipment
-  Flowchart for the full procedure (based on your original image)
-  Infographic-style layout for key steps

3. Customized Style

-  Theme: Choose a color scheme (e.g., coffee tones: browns, creams)
-  Fonts: Modern, clean, or scientific
-  Layout: Include sidebars, section headers, or icons

Let's Get Started!

First, can you tell me:


- Do you want real data for charts, or should I use sample values?
- Any specific visuals or colors/fonts/themes you like?
- Should I add a title slide with your name/project info?

Once I have that, I'll start upgrading your presentation.

Start upgrading your presentation.

ChatGPT Response:

The presentation has been upgraded with a bar chart showing acrylamide concentration by roast level.

 [Click here to download the updated version](#)

Would you like to continue with:

- Adding more visuals (photos, icons, flowchart)?
- Creating a custom color theme (e.g., coffee tones)?
- Including a cover slide with your name/project info?

Let me know what you'd like next!

This figure visually explains the transformation of coffee beans during the roasting process, including physical and chemical changes that occur. Here's a breakdown by section:

1. Coffee Bean (Raw State)

- Shows fresh coffee cherries on the plant.
- These red cherries contain the coffee seeds (beans) inside.
- Image represents the starting point before processing.

2. Coffee Roaster

- Represents the machine used to roast raw coffee beans.
- Roasting applies heat, initiating both endothermic and exothermic reactions.

3. Coffee Bean Structure

- A cross-sectional diagram of the coffee cherry and seed layers, labeled 1–7:
- Center cut
- Bean (endosperm)
- Silver skin (testa, epidermis)
- Parchment (hull, endocarp)
- Pectin layer
- Pulp (mesocarp)
- Outer skin (pericarp, exocarp)
- Source: [Wikimedia Commons](#)

4. Endothermic Reaction

Occurs during the initial roasting phase:

- Absorbs heat
- Temperature increases
- Water evaporates from the bean
- Bean structure starts to change (but not yet browned)

5. Roasted Coffee Bean Structure

- Two types of roasted beans shown:
- Arabica
- Robusta
- Differences in surface texture, size, and internal chemistry due to variety and roast profile

6. Exothermic Reaction

Occurs during the later phase of roasting:

- Releases heat
- Weight loss due to moisture & gas release
- Formation of flavor compounds, including acrylamide, aromatics, melanoidins, etc.
-

Explain this figure

ChatGPT Response

This figure visually explains the transformation of coffee beans during the roasting process, including physical and chemical changes that occur. Here's a breakdown by section:

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Occurs during the later phase of roasting:

- Releases heat
- Weight loss due to moisture & gas release
- Formation of flavor compounds, including acrylamide, aromatics, melanoidins, etc.

Overall Message

This diagram illustrates how raw coffee cherries are processed through roasting, involving complex heat-driven transformations—some absorbing energy (endothermic), others releasing energy (exothermic)—leading to the final roasted bean we use for brewing.

Would you like this figure added to your PowerPoint with a brief explanation like this?

Explain this figure**ChatGPT Response:**

This figure illustrates a Simulation Flowchart of an AI-Based Coffee Roasting Process, showing how neural networks and data feedback loops can optimize coffee roasting for improved flavor and sensory quality.

Let's break it down step by step:

1. Neural Network (AI Core)

- A neural network model receives input data from past roasting sessions.
- It processes the data to predict optimal roasting parameters:
 - Roasting temperature
 - Roasting time
 - Roaster speed
 - Other control variables
- These parameters are then sent to the coffee roaster.

2. Coffee Roaster

- The roaster executes the instructions (temperature, time, etc.).
- During roasting, various chemical reactions occur:
 - Endothermic reactions (energy absorbed):
 - ① Weight loss
 - ② Formation of certain chemical compounds
 - Exothermic reactions (energy released):
 - ① Pyrolysis (thermal decomposition)
 - ② Maillard reaction (crucial for flavor)
 - ③ Caramelization
- Data on contaminants (e.g., acrylamide) may also be collected.

3. Data Analysis & Taste Testing


- After roasting, a flavor (taste) test is conducted:
- Data analysis of roast profile, chemical composition, and flavor markers
- Visualization of sensory and analytical results

4. Sensory Evaluation by Humans

- Human testers evaluate:
 - Flavor
 - Aroma
- Results are subjectively assessed to ensure the coffee meets sensory expectations.

5. Data Feedback Loop

- All collected data (chemical reactions, contaminants, flavor scores, sensory feedback) is sent back to the neural network.
- This continuous loop allows the AI model to learn and improve future roasting predictions and parameter control.

 **Summary**

This system uses AI and machine learning to simulate and optimize the roasting process. The goal is to achieve:


- Consistent flavor quality
- Efficient roasting parameters
- Minimal harmful byproducts (like acrylamide)

It's a great example of how data science and sensory science can combine to modernize traditional processes like coffee roasting.

Would you like this figure added to your PowerPoint with a simplified caption or speaker notes?

Show the results of simulation**ChatGPT Response**


To show the results of the simulation, we can create a mock-up of realistic output you'd expect from an AI-based coffee roasting process. These results usually include:

 **Simulated Roasting Results (Sample)**

Roast ID	Temperature (°C)	Time (min)	Acrylamide (µg/kg)	Flavor Score (/10)	Aroma Score (/10)	Roast Type
R001	180	8	420	6.5	6.8	Light
R002	195	10	300	7.8	7.5	Medium
R003	210	12	180	8.3	8.0	Medium-Dark
R004	225	14	100	7.2	7.0	Dark

 **Interpretation**

- As roast temperature and time increase, acrylamide levels decrease due to thermal breakdown.
- Flavor scores peak at medium to medium-dark roasts—often preferred by cuppers.
- Aroma quality is also optimal in that range.
- Very light roasts have high acrylamide but lower flavor complexity.
- Very dark roasts may have lower acrylamide but start to lose some aromatic nuances.

 **Want a chart for this?**

I can generate:

- A line chart: Acrylamide vs. Roasting Time
- A bar graph: Flavor Score by Roast Type
- A combined plot showing temperature vs. sensory score

Let me know which chart(s) you want included in your presentation and I'll generate them!

Would you like me to:


- Add this chart to your presentation?
- Create a slide summarizing these sensory trends?
- Add speaker notes or analysis text for this chart?

Let me know how you'd like to proceed!

Add this chart to your presentation? Create a slide summarizing these sensory trends? Add speaker notes or analysis text for this chart?

ChatGPT Response:

Done! The chart has been added to a new PowerPoint slide along with a summary and speaker notes.

 Click here to download the updated presentation

Let me know if you'd like to add more visual content, simulation results, or style adjustments!


Add more visual content, simulation results, or style adjustments

ChatGPT Response:

Awesome! Let's give your presentation some polish and punch. Here's what I suggest, and you can pick all or just what you like:

 **STYLE ENHANCEMENTS**

1. Visual Content Additions

- Add the coffee roasting process diagram (the one showing coffee bean structure, endo/exothermic reactions).
- Add the AI roasting simulation flowchart.
-  Optionally add icons/photos: coffee beans, cupping, LC-MS/MS, etc.




2. Simulation Results Slide

I'll create a clean table with:

- Roasting Temp / Time
- Acrylamide levels
- Flavor & Aroma scores
- Roast Type



Plus a short summary on what the simulation shows.


3. Theme / Style Adjustments

-  Coffee-inspired color palette: warm browns, cream, and dark roast shades.
-  Clean, modern fonts
-  Section headers or transitions (e.g. "Simulation Results", "Sensory Analysis")

Let's confirm:

Would you like me to:





- Add both visual diagrams you shared? (Coffee roasting + AI simulation)
- Add simulation results as a table?
-  Apply a coffee-themed style across slides?
-  Add a final conclusion or summary slide?


Reply "Yes to all" or let me know which parts to include 

All of them

ChatGPT Response:

Your upgraded presentation is ready with:

-  Simulation results and sensory score charts
-  Visual flowcharts of the roasting process and AI system
-  Coffee-themed style with organized slides
-  Speaker notes and a final conclusion

 [Click here to download your final styled presentation](#)

Let me know if you want to turn this into a poster, research paper, or need help practicing your script!

VI. CONCLUSION

This paper studies the possibilities of application to coffee bean roast process. The flavor is so complex and depending on strongly on roast ways. It was done by manually or automation of some parts in roast process by mechanical methods. However, AI technologies increase to apply to many areas including agriculture. Some researches provide smart farm strategy through reviewing many reports and papers on how much generative LLM impact on agriculture like coffee industries. LLM impact is so high and should prepare for the future. At this point, we do not figure out what factors will give an impact on coffee bean agriculture leading factor because of short data and limited simulation for fruit of coffee industries.

The simulation suggests that ChatGPT shows the results of roast technologies. Of course, we can absolutely believe but at least we can have many ideas and process of roast. Some results can be believed well by experts.

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