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Brewing Excellence: Improving Coffee Quality with the V60 Stirred-agitation Technique

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ABSTRACT: Manual coffee brewing is the preferred method owing to its capacity to produce a more delicate and diverse range of flavors. While extensive research has been conducted on the process of coffee brewing, there has been limited discourse on the impact of agitation techniques on the quality of the steeping phase. The primary objective of this study is to explore the influence of agitation methods, specifically V60 and Kalita, on the quality of the steeping process. A survey-based investigation was conducted, analyzing sensory attributes such as flavor, aftertaste, acidity, body, balance, sweetness, overall flavor, acid intensity, and body level. A panel of twenty skilled baristas participated as evaluators. The findings of this research demonstrate that agitation plays a crucial role in achieving optimal extraction during the coffee brewing procedure. The particular agitation method employed distinguishes the brewing process and the final steeping outcome. Notably, the use of stirred agitation in the V60 method results in a well-balanced steeping flavor characterized by an acidic orange aroma and a subtle undertone of brown sugar, all without leaving a lingering, cloying aftertaste. The brewed coffee produced using this method exhibits a moderate level of acidity and body, alongside a subtly sweet flavor profile that contributes to an enhanced overall taste experience.

KEYWORDS: coffee agitation; coffee brewing; coffee extraction; coffee quality; pour-over

Introduction/Background

Coffee holds a noteworthy position among the widely consumed beverages worldwide (Khuwijitjaru et al., 2020). Coffee consumption is now becoming a part of urban lifestyle and encourages the growth of coffee shop businesses. In many countries, coffee has become an essential commodity and a highly favored drink (Leow et al., 2021) and the world's most popular stimulating beverage that is recognized and appreciated for its sensorial attributes (Zapata et al., 2019). The coffee's distinct aroma and flavor are highly valued by coffee lovers, either brewed traditionally or using modern technology, such as pressed or espresso (Nadaleti et al., 2019). Due to its polygonal structure, coffee possesses antioxidants and enhances cognitive function in the brain (Reta et al., 2017). Coffee consumption stimulates brain function and serves as a mood booster (Ahmed et al., 2019; Johnson, 2013; Kingston, 2015;

Tofalo et al., 2016). Caffeine, trigonelline, chlorogenic acid, cafestol, and kahweol are just a few of the active compounds in coffee that affect the body's metabolism (Lim et al., 2019; Moeenfard & Alves, 2020; Tofalo et al., 2016). Coffee has the most abundant source of bioactive compounds (Górecki & Hallmann, 2020), with over 1800 different volatile and non-volatile compounds influencing aroma (volatile) and viscosity, bitter flavor, astringency, and acidic properties (non-volatile). Caffeine, antioxidants, and oils are important non-volatile compounds for organoleptic properties and coffee functions (Zamanipoor et al., 2020). Chlorogenic acid and caffeine are nutritional components among these compounds (Jeon et al., 2019).

In Indonesia, coffee shop has grown to be one of the leading sub-sectors of creative economy industry and contributed to 76% of the creative economy's Gross Domestic Product (Indonesia Creative Economy Board, 2019). According to Indonesia's Annual Coffee Consumption data, domestic coffee consumption in 2019/2020 increased by 13.9% compared to the previous year (Global Agricultural Information Network, 2019). This trend encourages exploration to obtain the best quality brewed coffee, from planting to roasting, brewing, and serving. As a result, coffee characters begin to be explored further, including viscosity, acidity, aftertaste, and flavor combinations. Several factors influence the sensory characteristics of coffee beverages, such as plant varieties, growth conditions, methods for processing coffee cherries, roasting rates, coffee milling sizes, and brewing methods (Cordoba et al., 2020).

Coffee brewing is a method of making beverages by blending coffee grounds and water (Zamanipoor et al., 2020). Extraction pressure, coffee ground ratio, water quality, contact time, coffee grind size, and temperature are factors to be considered in brewing. These variables influence the extraction of bioactive and volatile compounds, thereby affecting the flavor profile of brewed coffee (Cordoba et al., 2020). Chemical reactions occur during brewing, releasing volatile compounds from roasted coffee, specially when using hot water (Colonna-Dashwood & Jay, 2017). Brewing is the process of extracting/absorbing flavor and other chemical compounds from coffee grounds, which affects the quality of the brewing results (Cordoba et al., 2020; Easto, 2017). Coffee brewing methods are differed according to geographical location, social and cultural environment, and individual preferences (Cordoba et al., 2020; Gloess et al., 2013), and the tools used: manual and machine-use methods. Manual brewing is a method of brewing without using an espresso machine and considered more approachable. Pour-over brewing involves pouring hot water over coffee grounds and placing them on filter paper. This method is preferred and well-known among coffee connoisseurs because it produces a lighter, more balanced, and varied flavor.

The pour-over method involves pouring hot water over the coffee grounds above the filter. The pour-over method with V60 or Kalita has become a barista preference because of its easiness. V60 and Kalita are the process of making coffee using a pour-over technique includes streaming hot water over the coffee grounds (Zamanipoor et al., 2020). The difference of both methods is V60 contains a bigger opening for coffee to pass through in one go compared to the Kalita, which features a bottom that is tightly sealed with three smaller holes. A cone-shaped dripper with a ridge along the inner edge and one large hole at the bottom, a paper filter, and glass vessels comprise the V60. Kalita is wavy in shape and has three holes in the bottom. These allow the coffee to be submerged in water for a longer period of time (Fibrianto et al., 2019). Pour-over coffee brewing produces satisfying coffee characteristics such as a more robust aroma, and clean coffee results, and highlights specific characteristics. For these reasons, coffee enthusiasts adore this method. Brewing with an espresso machine, on the other hand, resulting in coffee with greater bitterness, astringency, roast, and more robust overall aroma intensity (Frost et al., 2020).

Several primary factors influence the quality of brewed coffee, such as the quality of coffee beans, roasting rate, size of coffee grinds, a ratio of coffee ground and water, brewing method, water temperature, extraction time, agitation/turbulence, and pressure (for espresso) (Angeloni et al., 2019; Bhumiratana et al., 2011; Bladyka, 2016; Górecki & Hallmann, 2020; Lim et al., 2019; Zamanipoor et al., 2020). Agitation can be accomplished in two ways: using a stirring stick or shaking the brew (swirling). The technique of swirling encompasses delicately rotating the cup or vessel in a circular manner, facilitating the natural mixing of the liquid contents without the utilization of a spoon or stirrer. Contrarily, stirring entails the utilization of a spoon or stirrer to ensure that all the coffee grounds are evenly saturated and contribute to a uniform extraction (Colonna-Dashwood & Jay, 2017). The agitation method generates turbulence, which causes the coffee particles to separate, allowing water to pass through. Insufficient turbulence causes the coffee to fail to pass through the entire surface, resulting in uneven extraction. Inadequate extraction will result in an acidic flavor in the brew. However, too much agitation causes excessive turbulence in the coffee and induces the extraction to be completed too quickly, resulting in a bitter flavor in the brewed coffee (Johnson, 2013).

Stirring with a stick or swirling a brewing cup are two methods for performing agitation techniques. The vicinity of the stirrer is also important to consider when using the swirling technique. The agitation technique also contributes to the improved quality of the final coffee beverages. Although the coffee industry has adopted some brewing techniques, there is little scientific data on the subject (Cordoba et al., 2020). Much empirical research has been conducted on coffee brewing, but agitation in the brewing process has received less attention (Claassen et al., 2021).

Coffee plays such an important role in luring travelers to certain areas, thus responsible tourism is inextricably linked with it. Coffee-growing regions are frequently used as tourist destinations, showing not just the varied diversity of coffee flavors, but also the local culture and intricate production methods (Casalegno et al., 2020). To be responsible, it is essential to recognize the significance of sustainable practices not only at the destination but also in the products we consume. Thus, this study focuses on examining the effects of various agitation techniques on the quality of brewed coffee using the pour-over V60 and Kalita methods with (a) stirring and (b) swirling techniques. Sensory attributes are used by researchers to analyze processes and products.

Research Procedure

This study used a descriptive quantitative approach by comparing two manual pour-over brewing methods (V60 and Kalita) using different agitation techniques. Arabica coffee was used, with varieties Sigararutang grown in the Cikuray area of Garut, Indonesia. Arabica coffee had distinct flavors (citrus and berry flavors with a slight aroma of brown sugar) and a moderate acidity level, making it suitable for manual pour-over brewing. Arabica coffee had more antioxidants than Robusta coffee despite having less caffeine. Arabica coffee also had a better flavor and a lower acidity level. Robusta, on the other hand, contains sulphur compounds (Kingston, 2015; Lim et al., 2019)

The controlled variables in this study were the water-temperature ratio, grinding size, and roasting rate of coffee beans. To achieve a balanced flavor, the experiment used moderately roasted coffee. Excessive roasting time would result in bitter coffee beans, whereas too fast roasting time would not allow for optimal flavor exploration (Lim et al., 2019). The coffee beans were ground to a medium size to avoid excessive extraction, which would result in a bitter flavor.

Water temperature played an essential role in the extraction of chemical compounds from coffee grounds. The higher the water temperature, the more potent the kinetic energy of water molecules in extracting the volatile compounds in the coffee grounds. As a result, it affected the sensory attributes of steeping results. Different temperatures extracted different aromatic compounds. Water closing to the boiling temperature would produce a burnt flavor in the brewed coffee (Colonna-Dashwood & Jay, 2017). As a result, the excessive water temperature would increase acidity, while cold water would bring out sour notes in the cup. To optimize extraction, the ideal water temperature range for brewing coffee was 198-205^{0}F or 92^0-96^{0}C (Caprioli et al., 2015; Freeman et al., 2012; Johnson, 2013; Thurston et al., 2013) and adjusted to the grinding level of coffee (Batali et al., 2020). In this study, the standard recipe was 60 grams of coffee / 1 litre of water or 1 gram of coffee / 16.6 grams of water (Hoffmann, 2018). A high brew ratio results in a thick mouthfeel, muddled flavors, and pungent aroma, whereas a low brew ratio results in a thin mouthfeel, weak flavors, and faint aroma (Easto, 2017). This ratio was optimal for this type of coffee brewing.

Considering factors of willingness, capability, and availability, twenty trained baristas participated in sensory tests on four brewed coffee products as research panellists. Panellists' selection is according to their work experiences (with minimum of three years experience) and product sensitivity. Panellists were not permitted to consume food and beverages or smoke for at least one hour prior to the testing process. There was no interaction between panellists during the testing process to ensure the objectivity of the sensory assessment outcome. Panellists were presented with uniform cup containers and portion sizes when tasting the brewed coffee and had the option to sample a product multiple times and cleanse their palate with fresh water to ensure precise assessments (Kemp et al., 2009). The adequacy of the panellists' quantity has been deemed consistent with the study of (Mammasse & Schlich, 2014), explaining that the number of panellists can range from 20-150.

The purpose of observing the brewing process and the steeping outcomes was to investigate how different agitation methods affect the quality of brewed coffee. To assess the steeping results, sensory attributes such as flavor, aftertaste, acidity, viscosity, balance, sweetness, and overall flavor were employed (Folmer et al., 2017). Questionnaires were employed to gather data for evaluating these sensory attributes. The assessment criteria for flavor, aftertaste, acidity, viscosity, balance, sweetness, and overall flavor included categories like "good" (6.00-6.50), "excellent" (6.75-7.50), "specialization" (7.75-8.00), "excellence" (8.25-8.50), and "outstanding" (8.75-9.50). Additionally, acidity and viscosity levels were assessed using rating scales ranging from low to high. The sensory test results were subsequently analyzed by calculating mean values to identify the most effective methods and techniques for producing high-quality coffee (Folmer et al., 2017). The sensory test results are then analysed using mean values to determine the best methods and techniques for brewing high-quality coffee.

Results

As illustrated in Table 1, the V60 requires a longer total brewing time than the Kalita. Stirred agitation, as a sub-component of the V60 method, extends the brewing period beyond that of the Kalita method. In particular, the process of stirred agitation requires an additional six seconds for the initial blooming phase in the V60 method and an extra thirteen seconds in the case of the Kalita method. In coffee brewing, blooming signifies the liberation of carbon dioxide gas from freshly ground coffee upon contact with hot water. This reaction causes the coffee to expand or "bloom." It's considered to improve flavor extraction, leading to a richer and more aromatic coffee experience (López et al., 2021). The initiation of blooming is triggered by the contact of hot water with the coffee grounds, leading to the release of carbon dioxide and the characteristic blooming appearance. This blooming process exerts a discernible influence on the resultant flavor of the brewed coffee. The duration of the blooming process directly correlates with the amount of carbon dioxide gas that evaporates from the coffee, with longer blooming durations resulting in more significant carbon dioxide evaporation.

Table 1 also depicts the distinct outcomes of steeping process when utilizing both the V60 and Kalita methods, employing either stirred or swirled agitation. In regard to the characteristics of the steeping results, when the V60 method is coupled with stirred agitation, it yields a steeped coffee with a relatively modest level of acidity and a moderate viscosity. The flavor profile is subtly reminiscent of oranges, accompanied by a faint aroma of brown sugar, resulting in a balanced overall character. Conversely, when swirled agitation is applied, it results in a notably higher intensity of acidity and a less pronounced level of viscosity. Consequently, a more pronounced sour flavor prevails, featuring citrusy notes and a subtle undercurrent of brown sugar aroma. Table 1 also illustrates that steeping with Kalita using stirred agitation yields in a moderate level of acidity and viscosity. There is a sour citrus flavor with a slight tobacco and clove aroma. It has a relatively high sour flavor and medium viscosity for those who use swirled agitation. The sour citrus flavor dominates the flavor of the drink, with a slight clove aroma.

Table 1: Process Analysis of Coffee Brewing

Criteria		V60		Kalita	
		Stirred agitation	Swirled agitation	Stirred agitation	Swirled agitation
Brewing time	total	2.46	2.40	2.24	2.09
	First pouring (blooming)	0.35	0.26	0.22	0.22
	Second pouring (blooming)	1.29	2.14	2.02	1.45
Character		Low acidity level with a medium body level. Steeping character is relatively balanced, with a slightly orange taste and a hint of brown sugar	A higher acid intensity and a lighter body. The sour taste is more dominant, with a sour orange taste and a slight aroma of brown sugar.	A medium level of acidity and body. There was a sour taste of orange with a hint of tobacco and cloves.	A relatively high sour taste with a medium body. The sour taste of orange tends to dominate the brew's flavor, with a slight smell of cloves.

aroma.

Table 2 shows that steeping results differ between V60 and Kalita by using both stirred and swirled agitation. The V60 method, combined with stirred agitation, produces a complex and balanced coffee flavor. The brew has a sour citrus flavor with a slight aroma of brown sugar without any lingering aftertaste. While the final result of steeping for a swirling technique is dominated by a sour flavor.

Table 2: Product Analysis of the Brewed Coffee

Indicator	V60		Kalita	
	Stirring technique	Swirling technique	Stirring technique	Swirling technique
Flavor	Complex taste with a sour-orange taste and a hint of brown sugar aroma, medium acidity level.	Sour taste is dominant.	Fairly complex taste, with a slightly sour taste of berries and oranges with a hint of tobacco and cloves. The flavor character is relatively balanced.	The sour taste was quite dominant. There is a slight smell of cloves in this brew.
Aftertaste	Clean and no lingering aftertaste and. It has a moderate level of body without any bitter taste.	Stickier or lingering aftertaste in the throat.	A little stickier /lingering aftertaste.	Lingering aftertaste and is entirely left behind in the throat. This method produces a medium thickness and tends to be relatively high.
Acidity	Medium acidity level.	No even distribution of extraction produced the level of acidity in this brew is quite dominant	Relatively medium acidity level.	Relatively high acidity level and dominates the resulting steeping. It is due to the unequal extraction in the brewing process. In the first pouring process, water penetrates the surface of the coffee faster and causes the sour taste of the coffee to increase.
Body	The body level is pretty medium because turbulence occurs in the brew, causing the body to increase.	The body level is relatively low, and this is due to the lack of turbulence which causes a faster extraction time and causes the low body of the coffee.	The body level of this brew is reasonably medium. This brewing method produces a consistency of body level	The thickness of this brew is relatively medium. This brewing method produces a consistency of body level
Balance	It has a good balance. There is no dominant flavor in this brewed coffee.	The level of balance is somewhat less balanced, with a quite excellent sour taste dominant.	The brew is quite balanced, but only a slightly sweet taste appears.	The sour taste somewhat dominates the brewed coffee. It hardly feels the sweet taste of this brew.
Sweetness	It has a slightly sweet taste, caused by the incomplete burnt sugar content in the coffee during the roasting process.	There is no sweet taste in the brew because a sour taste dominates it.	There is a slightly sweet taste in the brew because of the incomplete burnt sugar content during the roasting process.	The sour taste dominates and eliminates the sweetness.
Overall taste	The overall taste is quite good, with its balanced taste. There is no overlapping taste.	Sour taste dominates the overall taste. The resulting sour taste has a tart taste to berries and oranges.	The overall taste is relatively balanced. In addition, the brewed coffee has a relatively good consistency of body level.	A sour taste somewhat dominates the overall taste, but it has a reasonably consistent body level in the steeping results.

Figure 1 depicts the outcome of the sensory evaluation. The stirred V60 method received the greatest scores from the panellists for aftertaste, balance, sweetness, and overall criteria. The stirred V60 earned the best score (7.03) for the aftertaste criterion due to its clean, light aftertaste and non-sticky tastes. The stirred V60 likewise produces a balanced coffee brew and received a score of 7.35. Regarding sweetness, the panellists prefer the coffee brew generated by the stirred V60 method due to its brown sugar-like sweetness (score 7.01). While the coffee brewed using the swirling Kalita method created a body of medium viscosity and received the highest rating from the panellists (score 7.11). The swirling V60 received the greatest scores for both flavor and acidity. The swirling V60 method received the highest score for flavor because it produced the most nuanced and well-balanced coffee brew (score 7). It also created a moderate amount of acidity and received a score of 7.19. The stirred method received the greatest overall score for making coffee brew with a flavor and acidity balance.

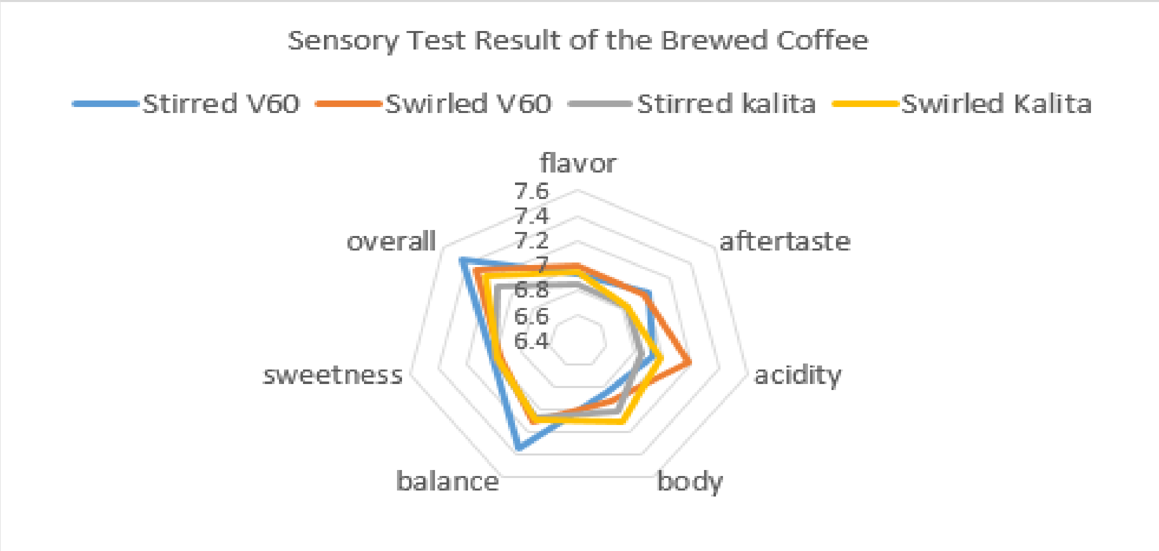

Figure 1: Sensory Test Result of the Brewed Coffee

Discussions

During brewing, there will be a process of water extraction against coffee grounds. Although it does not last long, the extraction process will significantly affect the quality of the steeping results (Cordoba et al., 2020), due to their distinct chemical compounding and sensory properties (Lim et al., 2019).

The roasted coffee beans will yield the flavor produced during the roasting and grinding process. In addition, the brewing stage extracts odorant and flavor molecules from roasted coffee. As a result, brewing methods play an essential role in producing a balanced flavor of the coffee beverage (Folmer et al., 2017). The optimal extraction of coffee grounds with water will affect the quality of the brewed coffee. Two parameters determine measurements against extraction. The extraction result is the first parameter, indicating the mass ratio of the extraction yield (dissolved coffee ground) to the coffee ground used (Angeloni et al., 2019; Wang et al., 2016). The temperature of water used, the size of the coffee ground, the agitation given, the ratio of water and coffee grounds, and the length of the brewing are some factors that contribute to the extraction result (Wang et al., 2016). When approaching 93 °C, it refers to optimal steeping. It is a crucial parameter because it is frequently regarded as an optimal shade (Batali et al., 2020). These factors will affect the sensory attributes of the extraction result. Specialty Coffee Association of America explains that optimal extraction is 18 – 22% to produce quality brewed coffee (Mestdagh et al., 2017). The second parameter is total dissolved solids (TDS) as a proportion of dissolved mass in brewed coffee (Batali et al., 2020; Cordoba et al., 2020; Wang et al., 2016). When water does not evenly wet all particles of coffee ground, extraction is not optimal. Agitation is required to allow water to penetrate all coffee ground particles, maximizing the extraction process. Excessive agitation, on the other hand, is not recommended because it can interfere with rapid extraction, resulting in a bitter flavor in the coffee brew (Johnson, 2013).

Agitation allows water to penetrate coffee ground evenly and consistently, thereby increasing the extraction. A significant increase in the extraction process will intensify the extraction yield and total dissolved solids, consisting of some chemical compounds, into the brewing results. The increased extraction of chemical compounds in coffee grounds will be responsible for sensory characters. According to Das and Eun (2018), agitation contributes to improving extraction yields. The use of swirled agitation lasts faster than stirred agitation. For the V60 method, the first pouring time (blooming) takes around 26 seconds or 4 seconds faster for Kalita. Stirred agitation, on the other hand, requires more than 30 seconds for blooming time. The blooming will affect the flavor of the brewed coffee. The longer the blooming process continues, the more carbon dioxide gas in the coffee will evaporate entirely. Carbon dioxide gas tends to give the coffee a bitter flavor if it hasn't evaporated completely.

The poured hot water will come into contact with the surface of the coffee, causing the coffee to emit carbon dioxide and appear to be blooming. The blooming process occurs in three stages: first, hot water comes into contact with the coffee surface, causing the coffee to release carbon dioxide gas and expand. Carbon dioxide gas forms a barrier between the coffee's surface and the water. It takes some time for the gas to be completely released, and it takes some time to wait for the gas to completely evaporate so that there is no bitter flavor effect and the brewing quality is optimal. Some gases and chemical compounds found in solid particles dissolve in water, resulting in the formation of flavor and aroma.

The fast-brewing time causes the water not to flow over the entire surface of the coffee and cannot extract the coffee optimally, resulting in a sour/acidic flavor in the coffee. On the contrary, the slow brewing time causes over-extraction and produces a bitter and pungent flavor to the brewed coffee (Hoffmann, 2018; Kingston, 2015; Mestdagh et al., 2017). Brewing time also depends on the coffee grind size. The finer the coffee grind, the longer it takes for the water to spread across the coffee surface (Easto, 2017). Therefore, the smaller coffee grind size will speed up the extraction time and result in over-extraction. Therefore, the smaller coffee grind size needs a faster contact time of water and coffee, and vice versa. In this study, the coffee grind size is a controlled variable. Whether stirred or swirled in agitation, this research used the same coffee grind size.

The swirled technique produces a more acidic flavor than stirred agitation. The stirred technique produces a better balance level due to its optimal extraction during the brewing process. The character of coffee brewing can range from pungent, sour, and fruity, to heavier, thicker, and finally bitter. Coffee with good extraction has a balance in each of these characteristics.

Permeability, which is the main parameter in influencing extraction because it determines the flow rate through the cup (Corrochano et al., 2015), compounds like caffeine and chlorogenic acid, aliphatic acid, carbohydrate degradation compounds that occur during the roasting process, and carbohydrates left in the coffee brew all have a strong influence on the quality of steeping (Mori et al., 2020). The analysis of steeping results covers the sensory attributes of flavor, aftertaste, acidity, body, balance, sweetness, and overall flavor. The V60 method's stirring technique produced a medium level of acidity with a complex flavor of brewed coffee. Coffee with even turbulence, produces a balanced flavor between acidity and thickness, and has a strong aroma. The swirling technique, on the other hand, affected dominant sour flavor due to the inequality of the extraction process (channelling) during the brewing process. Scents produced by this agitation technique are less aromatic. Uneven agitation causes the aroma not to be completely separated from the coffee brew.

The aftertaste tends to linger in the throat. It is a subpar extraction, which results in fewer water-soluble solids in the water during the brewing process. Whereas, the stirring method creates very cleanness without leaving a lingering aftertaste. The swirling technique increases the acidity level because of the penetration of water to the surface of the coffee dashes during the blooming process. It affects the sour flavor to intensify. The acidity level is more accepted (medium) for the stirring method due to an optimal and even extraction. Shorter time brewing and lack of turbulence cause the low body level. Intense agitation and longer brewing time increase turbulence and rise the body level. Because it takes longer to brew, The stirring method produces a more balanced for the overall flavor because it takes longer to brew. The swirling technique, on the other hand, imparts a more sour flavor.

The Kalita method's stirring technique produces a better quality of the brewed coffee. It has a complex and balanced character, with the hints of sour flavor, tobacco, and cloves, but no lingering aftertaste. The flavor is regarded as one of the most important factors influencing the quality of coffee beverages and the consumer acceptance. The duration of coffee ground contact with water during the extraction process influences the quality of the brewed coffee. Brewing temperature and contact time speed up the extraction of oils from coffee beans and release aroma and flavor in a particular way (Sinnott, 2011). The stirring technique results in a longer brewing time, moderate acidity level, body consistency, and a balanced overall flavor.

The sensory test, which involved twenty trained baristas, resulted in different manual brewing that significantly impacted sensory attributes. This finding supported previous research because a particular technique affected certain sensory characteristics of the steeping results (Sunarharum et al., 2020). The V60 method's stirred-agitation technique received the highest score of 7.08, placing it in the "very good" category. This steeping has a balanced flavor with an acid-like orange and a hint of brown sugar aroma, without leaving any sticky/lingering aftertaste. Concerning acidity and body, this brew has a medium level for both characteristics. In addition, a slightly sweet flavor emerges to enhance the overall flavor. The use of manual brewing techniques offer a means to mitigate the accumulation of plastic waste and the disposal of single-use packaging, which is frequently linked to instant coffee packaging and automated coffee machines.

The study's findings are consistent with the extant theories. Optimal extraction can produce extraction yield and total dissolved solids ratio for excellent steeping results (Ahmed et al., 2019; Frost et al., 2020). Turbulence/agitation can optimize extraction and produce well-balanced brewed coffee. This study implies that distinguished types of agitation can produce a different profiling character to the brewed coffee. For coffee lovers, the various profiling characters can provide a personalized flavor. As a result, this research can be beneficial to a barista, home brewer, or anyone involved in the coffee industry.

Water quality plays a critical role during the brewing process because of its effect on the brew's character. As a result, the consistency of water temperature, mineral levels, and acidity (pH) should become a remark (Bladyka, 2016). Mineral levels and acidity can vary even within the same brand. It is recommended to use distilled water because its low mineral content can produce an original flavor for coffee beverages. A pH meter is required to measure the acidity level of the water, as well as a TDS (Total Dissolved Solids) meter to determine the levels of dissolved minerals in the water. This finding can also encourage coffee business to use manual brewing to enhance consumer’s experience. Apart from the flavor, manual brewing methods can also provide a deeper and educated experience to visitors who want to learn about the coffee production process, spanning from the cultivation of coffee beans to the presentation in cups. Such involvement results in a greater understanding of the effort required to produce high-quality coffee and increased appreciation of sustainability in the coffee industry.

The findings of this study further aids in comprehending the extraction dynamics, pivotal in achieving a well-balanced coffee flavor (Mestdagh et al., 2017). Moreover, it aligns with the overarching objective of refining coffee brewing techniques, as illustrated by (Smith & Lee, 2021), aimed at enhancing the quality of the brewed coffee by adjusting brewing parameters.
To broaden the scope of research in coffee brewing and yield more comprehensive outcomes, additional methodologies beyond V60 and Kalita can be explored and employed for comparative analysis.

Conclusion

Consistent and even extraction will result in a good quality steeping result. Agitation can signal consistent turbulence, ensuring that all coffee grounds are extracted completely and optimally during the brewing process. Volatile and non-volatile, extracted compounds during the brewing process, will produce a balanced flavor. The type of agitation, whether stirring or swirling, distinguishes the brewing process and steeping results. The stirred agitation contributes to the better quality of the brewed coffee by creating more consistent turbulence that allows water to spread evenly. Stirred agitation of V60 also takes a longer brewing time resulting in a more balanced flavor of acidity, thickness, and pungent aroma. It has an acid-like orange and a hint of brown sugar aroma without leaving a sticky/lingering flavor aftertaste. Concerning acidity and body level, this brew has a medium level for both characteristics. Also, a slightly sweet flavor emerges to enhance the overall flavor.

References

Ahmed, M., Jiang, G. H., Park, J. S., Lee, K. C., Seok, Y. Y., & Eun, J. B. (2019). Effects of ultrasonication, agitation and stirring extraction techniques on the physicochemical properties, health-promoting phytochemicals and structure of cold-brewed coffee. *Journal of the Science of Food and Agriculture*, *99*(1), 290–301. https://doi.org/10.1002/jsfa.9186

Angeloni, G., Guerrini, L., Masella, P., Bellumori, M., Daluiso, S., Parenti, A., & Innocenti, M. (2019). What kind of coffee do you drink? An investigation on effects of eight different extraction methods. *Food Research International*, *116*, 1327–1335. https://doi.org/10.1016/j.foodres.2018.10.022

Batali, M. E., Ristenpart, W. D., & Guinard, J. X. (2020). Brew temperature, at fixed brew strength and extraction, has little impact on the sensory profile of drip brew coffee. *Scientific Reports*, *10*(1), 1–14. https://doi.org/10.1038/s41598-020-73341-4

Bhumiratana, N., Adhikari, K., & Chambers, E. (2011). Evolution of sensory aroma attributes from coffee beans to brewed coffee. *LWT - Food Science and Technology*, *44*(10), 2185–2192. https://doi.org/10.1016/j.lwt.2011.07.001

Bladyka, E. (2016). Coffee Brewing -Wetting, Hydrolysis & Extraction Revisited. *Specialty Coffee Association of America*, 1–7. http://coffee-brewing-methods.com/

Caprioli, G., Cortese, M., Sagratini, G., & Vittori, S. (2015). The influence of different types of preparation (espresso and brew) on coffee aroma and main bioactive constituents. *International Journal of Food Sciences and Nutrition*, *66*(5), 505–513. https://doi.org/10.3109/09637486.2015.1064871

Casalegno, C., Candelo, E., Santoro, G., & Kitchen, P. (2020). The perception of tourism in coffee-producing equatorial countries: An empirical analysis. *Psychology and Marketing*, *37*(1), 154–166. https://doi.org/10.1002/mar.21291

Claassen, L., Rinderknecht, M., Porth, T., Röhnisch, J., Seren, H. Y., Scharinger, A., Gottstein, V., Noack, D., Schwarz, S., Winkler, G., & Lachenmeier, D. W. (2021). Cold Brew Coffee—Pilot Studies on Definition, Extraction, Consumer Preference, Chemical Characterization and Microbiological Hazards. *Foods*, *10*, 1–20. https://doi.org/10.3390/foods10040865

Colonna-Dashwood, M., & Jay, T. (2017). *The coffee dictionary : an A--Z of coffee, from growing & roasting to brewing & tasting* (p. 253). San Francisco: Chronicle Books LLC.

Cordoba, N., Fernandez-Alduenda, M., Moreno, F. L., & Ruiz, Y. (2020). Coffee extraction: A review of parameters and their influence on the physicochemical characteristics and flavour of coffee brews. *Trends in Food Science and Technology*, *96*, 45–60. https://doi.org/10.1016/j.tifs.2019.12.004

Corrochano, B. R., Melrose, J. R., Bentley, A. C., Fryer, P. J., & Bakalis, S. (2015). A new methodology to estimate the steady-state permeability of roast and ground coffee in packed beds. *Journal of Food Engineering*, *150*, 106–116. https://doi.org/10.1016/j.jfoodeng.2014.11.006

Das, P. R., & Eun, J. B. (2018). A comparative study of ultra-sonication and agitation extraction techniques on bioactive metabolites of green tea extract. *Food Chemistry*, *253*, 22–29. https://doi.org/10.1016/j.foodchem.2018.01.080

Easto, J. (2017). *Craft Coffee: A Manual*. Chicago: An Agate Imprint.

Fibrianto, K., Wulandari, E. S., Jovino, A., Rahmawati, M. A., Wandani, N. C., Fibrianti, S., Waziiroh, E., & Yuwono, S. S. (2019). Brewing time and temperature optimization of Robusta Dampit Coffee on several drip techniques. *IOP Conference Series: Earth and Environmental Science*, *230*(1). https://doi.org/10.1088/1755-1315/230/1/012035

Folmer, B., Blank, I., Farah, A., Giuliano, P., Sanders, D., & Wille, C. (2017). *the Craft of Science of Coffee*. London: Elsevier Ltd.

Freeman, J., Freeman, C., & Duggan, T. (2012). *The Blue Bottle Craft of Coffee: Growing, Roasting, and Drinking. with Recipes*. Berkeley: Ten Speed Press.

Frost, S. C., Ristenpart, W. D., & Guinard, J. X. (2020). Effects of brew strength, brew yield, and roast on the sensory quality of drip brewed coffee. *Journal of Food Science*, *0*(0), 1–14. https://doi.org/10.1111/1750-3841.15326

Global Agricultural Information Network. (2019). Indonesia Coffee Annual Report 2019. In *USDA Foreign Agricultural Service*.

Gloess, A. N., Schönbächler, B., Klopprogge, B., D'Ambrosio, L., Chatelain, K., Bongartz, A., Strittmatter, A., Rast, M., & Yeretzian, C. (2013). Comparison of nine common coffee extraction methods: Instrumental and sensory analysis. *European Food Research and Technology*, *236*(4), 607–627. https://doi.org/10.1007/s00217-013-1917-x

Górecki, M., & Hallmann, E. (2020). The antioxidant content of coffee and its in vitro activity as an effect of its production method and roasting and brewing time. *Antioxidants*, *9*(4). https://doi.org/10.3390/antiox9040308

Hoffmann, J. (2018). *The World Atlas of Coffee* (2nd ed.). Ontario: Octopus Publishing Group.

Indonesia Creative Economy Board. (2019). *Laporan Kinerja Badan Ekonomi Kreatif Tahun 2019*.

Jeon, J. S., Kim, H. T., Jeong, I. H., Hong, S. R., Oh, M. S., Yoon, M. H., Shim, J. H., Jeong, J. H., & Abd El-Aty, A. M. (2019). Contents of chlorogenic acids and caffeine in various coffee-related products. *Journal of Advanced Research*, *17*, 85–94. https://doi.org/10.1016/j.jare.2019.01.002

Johnson, D. (2013). *How to Make Coffee Before You've Had Coffee*. Sausalito: Dymaxicon.

Kemp, S. E., Hollowood, T., & Hort, J. (2009). *Sensory Evaluation A Practical Handbook*. John Wiley & Sons, Ltd.

Khuwijitjaru, P., Boonyapisomparn, K., & Huck, C. W. (2020). Near-infrared spectroscopy with linear discriminant analysis for green "Robusta" coffee bean sorting. International Food Research Journal, 27(2), 287–294.

Kingston, L. (2015). *How To Make Coffee: The Science Behind The Bean*. New York: Abrams Image.

Leow, Y., Yew, P. Y. M., Chee, P. L., Loh, X. J., & Kai, D. (2021). Recycling of spent coffee grounds for useful extracts and green composites. *RSC Advances*, *11*, 2682–2692. https://doi.org/10.1039/d0ra09379c

Lim, L. T., Zwicker, M., & Wang, X. (2019). Coffee: One of the most consumed beverages in the world. In *Comprehensive Biotechnology* (Third Edit, Vol. 4, pp. 275–285). Elsevier. https://doi.org/10.1016/B978-0-444-64046-8.00462-6

López, M. E., Santos, I. S., de Oliveira, R. R., Lima, A. A., Cardon, C. H., & Chalfun-Junior, A. (2021). An overview of the endogenous and environmental factors related to the Coffea arabica flowering process. *Beverage Plant Research*, *2021*(1), 1–16. https://doi.org/10.48130/BPR-2021-0013

Mammasse, N., & Schlich, P. (2014). Adequate number of consumers in a liking test. Insights from resampling in seven studies. Food Quality and Preference, 31(1), 124–128. https://doi.org/10.1016/j.foodqual.2012.01.009

Mestdagh, F., Glabasnia, A., & Giuliano, P. (2017). The Brew-Extracting for Excellence. *The Craft and Science of Coffee*, 355–380. https://doi.org/10.1016/B978-0-12-803520-7.00015-3

Moeenfard, M., & Alves, A. (2020). New trends in coffee diterpenes research from technological to health aspects. *Food Research International*, *134*(March). https://doi.org/10.1016/j.foodres.2020.109207

Mori, A. L. B., Viegas, M. C., Ferrão, M. A. G., Fonseca, A. F., Ferrão, R. G., & Benassi, M. T. (2020). Coffee brews composition from coffea canephora cultivars with different fruitripening seasons. *British Food Journal*, *122*(3), 827–840. https://doi.org/10.1108/BFJ-03-2019-0203

Nadaleti, D. H. S., Rocha, H. A., Mendonça, L. M. V. L., de Mendonça, J. M. A., Reis, I. B. dos, Evaristo, C. H., & Terra, S. D. V. (2019). Sensory Quality of Roasted Coffee Beans Under Different Storage Conditions. *Coffee Science*, *14*(4), 509–517. https://doi.org/http://dx.doi.org/10.25186/cs.v14i4

Reta, Mursalim, Salengke, Junaedi, M., Mariati, & Sopade, P. (2017). Reducing the acidity of arabica coffee beans by ohmic fermentation technology. *Food Research*, *1*(5), 157–160. https://doi.org/10.26656/fr.2017.5.062

Sinnott, K. (2011). The Art and Craft of Coffee: An Enthusiast's Guide to Selecting, Roasting, and Brewing Exquisite Coffee. 176. https://books.google.com/books?id=2nZsiYAftV4C&pgis=1

Smith, A., & Lee, W. T. (2021). Brewing optimal coffee. European Journal of Physics, 42(2). https://doi.org/10.1088/1361-6404/abc97d

Sunarharum, W. B., Ahmad, R., & Primadiani, E. (2020). Effect of different manual brewing techniques to the sensory profile of the Indonesian Arabica and Robusta "natural coffees." *IOP Conference Series: Earth and Environmental Science*, *475*(1). https://doi.org/10.1088/1755-1315/475/1/012020

Thurston, R. W., Morris, J., & Steiman, S. (2013). Coffee: A Comprehensive Guide to the Bean, the Beverage, and the Industry. In R. W. Thurston, J. Morris, & S. Steimen (Eds.), *Rowman & Littlefield*. Maryland: Rowman & Littlefield.

Tofalo, R., Renda, G., De Caterina, R., & Suzzi, G. (2016). Coffee: Health Effects. In B. Cabalerro, P. M. Figlas, & F. Toldra (Eds.), *Encyclopedia of Food and Health*. Elsevier Ltd. https://doi.org/10.1016/B978-0-12-384947-2.00182-3

Wang, X., William, J., Fu, Y., & Lim, L. T. (2016). Effects of capsule parameters on coffee extraction in single-serve brewer. *Food Research International*, *89*, 797–805. https://doi.org/10.1016/j.foodres.2016.09.031

Zamanipoor, M. H., Yakufu, B., Tse, E., Rezaeimotlagh, A., Hook, J. M., Bucknall, M. P., Thomas, D. S., & Trujillo, F. J. (2020). Brewing coffee? – Ultra-sonication has clear beneficial effects on the extraction of key volatile aroma components and triglycerides. *Ultrasonics Sonochemistry*, *60*, 1–8. https://doi.org/10.1016/j.ultsonch.2019.104796

Zapata, A. M. O., Arango, F. O. D., & Rojano, B. A. (2019). The effect of gravity-drip filtration methods on the chemical and sensorial properties of coffee (coffea arabica l. var. castillo). *Coffee Science*, *14*(3), 415–426. https://doi.org/10.25186/cs.v14i3.1603