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Sensory characterization of unpeeled robusta coffee at different roasting temperature and time

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KEYWORDS

Optimization

Robusta

Unpeeled coffee

ABSTRACT

Unpeeled coffee is a traditional post-harvest coffee production method with minimum waste. However, its sensory quality is relatively inferior compared to the peeled coffee beans. The sensory characteristics of unpeeled coffee can be optimized after the natural drying process by determining the roasting temperature and brewing technique to improve sensory preferences on several attributes tested, such as sweetness, bitterness, sourness, and grassy flavor as roasting and brewing are two major processes for developing coffee flavors. The beans were pre-treated by natural sun-drying as well as oven drying. A Central Composite Design on Response Surface Methodology was used to optimize the roasting temperature within the range of 179°C and 221°C and the roasting time within the range of 10 to 20 minutes for the optimum bean's moisture content (%). The best-unpeeled coffee beans were obtained after three weeks of natural drying (approximately 28°C on average) and roasted at 221°C for 16 minutes. At this stage, the preferences for French-press brewed coffee were the highest, especially for the sweetness attribute. This might be supported by the fact that 2-methyl-5-hexen nitrile and 3-methyl-4-penten-1-ol were identified on GC-MS as the dominant detected volatile compounds.

Introduction

Coffee farmers usually use a post-harvest process with direct sunlight drying or a natural process. The natural process is done by separating the seeds from the pulp and skin. Furthermore, the coffee beans are naturally dried using sunlight. The drying process with sunlight causes natural coffee fermentation, which can improve the taste of the final coffee product. In other conditions, the post-harvest process carried out by coffee farmers can cause considerable waste. The natural drying process produces large quantities of pulp and skin waste, about 20 kg in 1 quintal of dried cherries. Most of the waste removed in coffee production is the pulp because the pulp has 35% of the weight in fresh coffee cherries (Hoseini et al., 2021).

Dampit sub-district is one of the areas where most coffee farmers use the post-harvest process. Based on data from the Central Bureau of Statistics of Malang Regency, coffee production is quite large, such as 2,387 tons in 2018. Located in the Dampit sub-district, Malang regency, Dampit Robusta coffee is one of the coffee plantation commodities currently receiving much attention. Dampit Robusta coffee is grown at an altitude of 900 meters above sea level, commonly called Dampit people's coffee or Dampit traditional coffee. The traditional Dampit coffee production process uses coffee that has not been peeled by drying it. An altitude of 900 meters above sea level is one of the requirements for planting superior coffee that can produce processed coffee with a unique taste.

The taste of coffee cherries can be affected by the growth rate of the fruit. Ripe coffee cherries have a sweeter pulp taste, more outstanding dissolved pectin content, higher chlorogenic acid, and higher phenols than ripe coffee cherries (Hu et al., 2020). Coffee cherries are generally harvested when ripe and possess a red color. The color of the fruit skin changes from dark green to red due to the phenomenon of loss of chlorophyll pigments and the accumulation of

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anthocyanin compounds at the final stage of fruit ripening (Lathifa .,et al, 2021).

The opportunity to implement a concept of zero waste or green technology for zero waste food production inside post-harvest coffee cherries without involving a peeling step into ground coffee is prospective. Zero-waste treatment is one of the innovations that can protect the environment without producing waste disposal and maximize all food components' potential nutrition. However, based on the preliminary study, processing whole coffee beans without peeling produce low sensory quality coffee due to the presence of several off-notes such as grassy flavor and intense burnt flavor. This study is primarily intended to evaluate the sensory characteristics of brewed coffee from unpeeled coffee cherries with different maturity levels, drying methods, and brewing techniques.

Research Methods

The research was carried out for two months at the Sensory Testing Laboratory and Applied Food Science, FMIPA Laboratory, Food Quality and Safety Testing Laboratory, Universitas Brawijaya Malang and Industrial Laboratory of PT. Various Coffee and Integrated Research and Testing Laboratory, Gadjah Mada University.

The materials used in this study were unpeeled commercial coffee grounds and robusta coffee beans from Dampit District, Malang Regency, East Java. The materials used in this study were running water, clean drinking water, distilled methanol, and acetonitrile solution. The tools used are water containers, clean sacks, Tupperware, a roaster, Minitab 19 application, spoons, analytical scales, silica gel analytical scales, PSA instruments, PSA tubes, a set of glass tools, spatulas, analytical scales, computer equipment, spatulas, a set of glassware, bulk density instrument, panelist questionnaire, stationery, spoon, mortar, and pestle, Millex 0.45 m filter, measuring pipette, bulb pipette, GC-MS instrument, vial autosampler, and computer.

Research stages

The research was conducted using two stages. The first stage was the Response Surface Methodology (RSM) Central Composite Design (CCD) design with a two-factor design with three different levels, including roasting temperatures (185, 200, and 215^{o}C) and roasting time. (10, 15, and 20 minutes) (Table 1). The results were then determined to determine the optimum moisture content (%). They conducted physical, chemical, and microbiological analyses using a particle size analyzer (PSA), bulk density, caffeine, total sugar content, zinc (Zn), yeast, and mold.

Table 1. Central composite design experimental design (CCD)

Factor	Name	Units	Low Level (-1)	Centers (0)	High Levels (+1)
X1	Temperature	C	185	200	215
X2	Duration	Minute	10	15	20

Run	PtType	Roasting Temperature (oC) X1	Length of Time (Minutes) X2
1	-1	178.79	15.0
2	1	215.00	20.0
3	0	200.00	15.0
4	1	215.00	10.0
5	0	200.00	15.0
6	-1	200.00	7.9
7	1	185.00	20.0
8	0	200.00	15.0
9	0	200.00	15.0
10	0	200.00	15.0
11	1	185.00	10.0
12	-1	221.21	15.0
13	-1	200.00	22.1

The optimization results obtained are then used for the second stage of research. The second stage evaluated sensory attribute tests on unpeeled coffee grounds with different maturity levels, drying methods, and brewing techniques on commercial unpeeled coffee grounds. The sensory attribute test data results are then observed for volatile compounds using Gas Chromatography-Mass Spectrometer (GC-MS). Sensory trait attributes are carried out using acceptance and preference level tests on 108 untrained correspondents.

Drying process of unpeeled robusta coffee

Robusta Dampit coffee cherries obtained in farmers' gardens are to be washed and sorted where the sunken coffee cherries are picked up. Robusta coffee cherries are then selected by separating them based on their color, such as ripe, half-ripe, and unripe. The coffee cherries were then dried by sun drying for three weeks and oven at 110^oC for 15 hours to get dried coffee cherries with a maximum water content (%) of 11-12.5%.

Response surface methodology (RSM)

Response Surface Methodology (RSM) is carried out using the Central Composite Design (CCD) design with the help of the Minitab 19 application. Response Surface Methodology (RSM) is used to determine the optimum water content (%) with two factors (X) and three levels of each factor, including the roasting temperature (X1) of 185, 200, and 215^oC, and the length of time (X2) of roasting 10,15, and 20 minutes.

Particle size analyzer (PSA) (Hoten, 2020) modification

A particle Size Analyzer (PSA) is widely used to test submicron dry samples in powder samples. PSA is used in several stages, such as inserting the prepared powder into a PSA tube containing as much water as the tip of the spatula. The next step is to interpret the data on a computer with particle sizes distribution of 10%, 50%, and 90%.

Bulk density (Prawira-Atmaja et al., 2018)

A sample of 10 grams of coffee powder was put into a 50 ml measuring cup and the initial volume of the powder sample was recorded. Measurement of the density of bulk powder samples from the average repetition of 10 times. Bulk density is calculated based on the following formula:

$$Pb = \frac{Wt}{Vb} \qquad (1)$$

Description:
Pb: Bulk Density (Kg.M^{-3})
Wt: Powder Weight (g)
Vb: The volume that is reading the measuring cup (ml)

Water content (SNI 01-2891-1992)

Weigh 1-2 g of unpeeled coffee grounds in a closed bottle of known weight. The sample was then heated in an oven at 105^oC for 3 hours. Cooling in a desiccator, then weighing the sample, repeat weighing until a constant weight is obtained. The water content is calculated based on the following formula:

$$\text{Water Content} = \frac{W}{W1} \times 100\% \qquad (2)$$

Description:
W: Weight of weighing bottle before drying (g)
W1: Weight of weighing bottle after drying (g)

Caffeine (SNI 01-3542-2004)

Quantitative analysis of caffeine using column chromatography, then read the absorbance using a spectrophotometer. Standard coffee solution 10μg caffeine/ml, 20 g caffeine/ml, and 30μg caffeine/ml. Weigh 100mg caffeine (USP, anhydrous) into a volumetric flask, dissolve in CHCl3 and adjust. Pipette 10 ml of the above solution into a 100 ml volumetric flask and dilute with CHCl3. Then pipette 10ml, 20 ml, and 30 ml of these solutions and put them in a 100 ml volumetric flask, dilute and adjust with CHCl3 to obtain standard solutions of 10μg caffeine/ml, 20μg caffeine/ml, and 30μg caffeine/ml.

Total sugar (ACI-MU-5.4.38)

Weigh 3 g of the sample, transfer it to a 250 ml volumetric flask and add ± 50 ml of distilled water. Stir until all the samples are dissolved. Add 5 ml of half-base lead acetate (PbCOOH). Add a few drops of 10% di-ammonium hydrogen phosphate ((NH4)2HPO4), shake and make sure a white precipitate form. Add another 15 ml of 10% di-ammonium hydrogen phosphate, shake and add distilled water to the volume until the solution settles. Perform the filtration process with filter paper, then take 50 ml of the filtered result into a 100 ml volumetric flask, then add 5 ml of 25% HCL and heat, then control the temperature of the solution at 69–70^{o}C for 10 minutes. The next step is to cool it in an ice bath. Neutralize the solution using 30% NaOH, then add distilled water to the mark and homogenize. Take 10 ml of the solution with a pipette and put it in a 500 ml Erlenmeyer cap, adding 15 ml of distilled water and 25 ml of Luff Schoorl's solution. Do the reflux process, and let it boil for 10 minutes. Remove and transfer the Erlenmeyer to an ice bath and allow it to cool.

The cold Erlenmeyer was then added to 15 ml of 20% KI solution and 25 ml of 25% H2SO4, then the titration process was carried out using 0.1 N Na2S2O3 as the titrant. Towards the end of the titration process, add the starch solution until a black solution is formed. The endpoint of the titration is indicated by a color change to white and record the volume of 0.1 N Na2S2O3 used is recorded. In determining the endpoint of the titration, add starch solution and it is expected that no black color will form.

Zinc (SNI 01-2896-1998)

Analysis of zinc (Zn) content using the dry ashing method with the principle of ash analysis in foodstuffs is determined by weighing the remaining minerals resulting from burning organic matter at a temperature of around 550^{o}C. The ashing process is carried out in 2 stages in the kiln to obtain a gray powder, the first stage at a temperature of around 300^{o}C and the second stage at a temperature around 420-550^{o}C. The ashing time of the material is carried out between 5-7 hours. The furnace is turned off, wait for the temperature to < 250^{o}C and take the cup. The cup is cooled in a desiccator, then weighed until it is constant.

Yeast and mold (SNI 01-2897-1992)

Yeast and Mold analysis used the Total Plate Count (TPC) test which has the principle of growing live microbial cells on media so that these cells multiply and form colonies that can be seen directly with the naked eye without using a microscope then the colonies can be calculated using a colony counter. Colony growth results from agar media. Total TPC is calculated using Colony Counter.

Modified french press coffee brewing (SCAA, 2016)

While all the protocols following the SCAA method the amount coffee was modified from 25 grams to 30 grams. Brewed using unpeeled coffee powder as much as 30 grams set on a medium to coarse grind. Addition of water at a ratio of 1:7 and 1:10 at 200 °F / 93.5 °C in brewing Additional water at 200 °F / 93.5 °C for preheating, stirrer, brewing time for 4 minutes and Scale gram used is 1 gram = 1 milliliter.

Modified V60 coffee brewing (SCAA, 2016)

While all the protocols following the SCAA method the amount coffee was modified. Instead of 25 grams, we used 30 grams for brewing. Place the filter in the V60 case mounted above the cup. Heat it by pouring hot water and discard the used water. Place the V60 case with the filter on top of the cup and place it all on the scale. Add 30 grams of coffee to the filter and mix well. Pour hot water thoroughly over all the coffee grounds and leave for 30 seconds. When all the water has been poured over the coffee grounds and the filter begins to drip very slowly, remove it and discard the filter. The addition of water used a ratio of 1:7 (30 g: 210 ml) and 1:10 (30 g: 300 ml).

Sensory attribute on flavor intensity and preferences test (Taylor & Francis, 2019)

The study involved 108 untrained correspondents. The main requirement of the correspondent is that the correspondent is not allergic to coffee drinks. Correspondents were asked to measure the sensory attributes of flavor intensity and preferences on 4 parameters, such as sweet, bitter, sour and grassy on a 5-level scale. The samples used in the sensory test of this study included ground coffee without skin with different levels of maturity, drying and brewing methods using commercial unpeeled coffee as a control sample.

Volatile compounds with gas chromatography-mass spectrometer (gc-ms), (Chia et al., 2021) modified

Gas Chromatography Analysis – Mass Spectrometer (GC-MS) with Thermo Scientific TM TRACE 1310 gas chromatography instruments and Thermo Scientific^{TM} ISQ LT Single Quadrupole mass spectrometer with miniLab library Chromatographic system using an

HP-5MS UI capillary column (0.25mm diameter and film thickness 0,25µm) with a retention time of 2-32 min. The injection was performed automatically use a Thermo Scientific™ Triplus™ RSH Autosampler at a maximum temperature of 325/350°C.

The sample preparation was diluted with solvent according to record (MeOH) in a microtube. The sample will be vortex until homogeneous, if necessary centrifuged at a speed of 9500 rpm for 3 minutes. Take the supernatant in a GC bottle. The sample solution is ready to be injected into the Gas Chromatography-Mass Spectrometer (GC-MS) instrument.

Data Analysis

The data obtained in the first and second stages were statistically analyzed using Minitab software version 19. The Minitab test was used to determine the interaction of factors with responses through the ANOVA test and determine the maximum yield using the data optimization test for the first stage of research. The second stage of research is the ANOVA test to determine the interaction of the formulation with each response given.

Results and Discussion

Preliminary research

Coffee cherries in Indonesia regulated under the quality standards according to Indonesian National Standard (SNI) number 01-2907-2008. General quality standards are identified with several analytical parameters, one of which is water content with a maximum requirement of 12.5% and maximum physical contamination of 0.5%. (Indonesia & Nasional, 2008). The quality of coffee cherries due to yeast and mold contamination is written in the Indonesian National Standard (SNI) 7388:2009, such as the maximum content of yeast and mold contamination is 1 x 104 colonies/g (Nasional et al., 2009). Based on Table 2, the content of dried coffee beans that have not been peeled has met the generally applicable quality standards.

Optimization of the Dampit unpeeled robusta coffee

Based on Table 3, the combination of roasting treatment for water loss in factual conditions was 21.66% ripe picking, 13.18% half-ripe picking and 19.38% unripe picking. The result of calculations using the Response Surface Method (RSM) using the Minitab 19 application shows that the best coffee optimization data was at 221°C ripe pick for 16 minutes which was close to the optimal condition of 21.28%. The results of the optimization data acquisition based on the Response Surface Method analysis above can be proven by a mathematical model as follows:

Moisture Content (%) ripe quote:
-27 - 0.02 Temperature + 5.50 Time Length + 0.00161 Temperature*Temperature – 0.0555 Time Duration*Time Length -0.0167 Temperature*Length of Time

Moisture Content (%) half-ripe Option:
-332.5 + 3.035 Temperature + 3.09 Length of Time – 0.00708 Temperature*Temperature – 0.0888 Length of Time*Length of Time – 0.00000 Temperature*Length of Time

Moisture Content (%) unripe Choice:
-213.1 + 1.883 Temperature + 2.26 Length of Time – 0.00428 Temperature*Temperature – 0.0735 Length of Time*Length of Time + 0.00167 Temperature*Length of Time

Physical characterization powder of the Dampit Unpeeled Robusta Coffee

The particle distribution of each coffee powder sample was analyzed using a Particle Size Analyzer (PSA). Based on the PSA results, the particles in each sample are generally different and displayed in Table 2. The relationship between particle size distribution and the brewing technique of coffee brew are strongly correlated. The smaller particle size of coffee grounds, especially at fine level or nearly powder size, can enhance a brewed coffee taste because water can pass more through the coffee particles. Thus, more compounds can be extracted from a fine level coffee ground size.

Bulk density plays a role in determining the packaging, storage and transportation of unpeeled coffee grounds. The average value of the density of unpeeled bulk coffee powder with different maturity levels, drying methods and commercial powders can be seen in Table 2. The lowest value for unripe coffee powder bulk density obtained from sun dried process. Unripe coffee cherries need more storage room compared to ripe coffee cherries due to free water content that affect the stiffness of coffee ground powder. Unpeeled coffee powder is less stiff than peeled coffee powder because of the water content reduction.

Table 2. Characterization of unpeeled coffee robusta Dampit

Parameter	Water content (%)	Caffeine (%)	Total Sugar (%)	Zn (mg/kg)	Particle Size (µM)	Bulk Density (g/ml)
Whole beans Robusta after Drying						
Unripe from Sun Drying	9.42	1.56	7.31	0.88	*	*
Half-Ripe from Sun Drying	9.56	1.63	4.11	ND	*	*
Ripe from Sun Drying	8.41	1.8	4.06	ND	*	*
Ripe from Oven Drying	6.99	1.26	8.75	1.07	*	*
Unpeeled Robusta Powder after Roasting						
Unripe from Sun Drying	1.63±0.0495 c	1.95±0.0076 a	1.78±0.00	ND	170.6±0.778b	0.3005±0.0076a
Half-Ripe from Sun Drying	1.26±0.0141 d	1.8±0.0063 b	1.5±0.00	2.567±0.0071 a	209,015±38,997b	0.2996±0.0063a
Ripe from Sun Drying	2.04±0.0354 a	1.64±0.0025 c	1.73±0.00	ND	216,025±53,691a	0.3469±0.0025a
Ripe from Oven Drying	2.08±0.0071 a	1.19±0.0257 e	1.15±0.00	4.692±0.0537 b	213.59±24.098a	0.3751±0.0257a
Commercial Coffee	1.75±0.0283 b	1.46±0.0071 d	0.76±0.00	ND	215.25±1.273a	0.3483±0.0071a

Note. The result of the analysis is the mean of 2 replications ± standard error: the numbers in the column followed by the same letter are not significantly different at p-values less than 0.05 according to Tukey's further test.

Table 3. The results of the optimization of the unpeeled robusta coffee roast

Sample	Variable	Water content (%)	
		factual	Optimal
Ripe	X1	21.66	21.28
Half-Ripe	X2	13.18	19.45
Unripe	X3	19.38	17.68

Chemical characteristics powder of the Dampit unpeeled robusta coffee

a. ***Water content (%)***

The highest water content was found in dried ripe robusta coffee powder dried from oven drying process because coffee beans were completely remained as a coffee cherry. Coffee cherries have 65% water content that increase and affect the water content of coffee powder products. Closed air circulation caused an increasement in water content of coffee grounds. On the other hand, roasting process factors including speed and constant drum air temperature, simultaneously decrease water content of cherry pulp. Schouten et al., (2020), explained that declining phenomenon of water content (%) and water activity (aw) were faster in early stages roasting process.

b. ***Caffeine (%)***

Caffeine is a stimulant agent with another name trimethyl xanthine contained in coffee cherries which can give a bitter taste to brewed coffee (Ruri Wijayanti et al, 2019). The highest caffeine content was found in the samples of Petik Hijau coffee which were dried in the sun at 1.95% and the lowest caffeine content was found in the samples of Petik Merah which were dried in the oven at 1.19%. The drying of ripe picks in the oven is done by drying with the help of a dryer which can affect the level of caffeine present. The increase in caffeine content is also closely related to the presence of skin and fruit around the coffee beans that lead to the sublimation process (opened the coffee bean cavities) of caffeine compounds when exposed at 178^{o}C roasting process. Large caffeine compounds from other components, causes the longer the high caffeine is roasted the higher.

According to Aryadi et al (2020) data on caffeine content can be caused by several factors, such as sample mass, temperature, coffee mixture and roasting time. High caffeine content in coffee can be affected by high roasting temperatures. The higher the roasting temperature, the higher caffeine content contained in coffee beans because the reduced liquid and acid will increase the amount of non-liquid ingredients such as caffeine, minerals and fats.

c. ***Total sugar*** **(%)**

The total sugar content of unpeeled coffee grounds ranged from 0.76-1.79%. These data indicate that the total sugar content in the control ground coffee is lower than the other ground coffee samples because of the post-harvest maturity color degree sortation process. Sugar content increases significantly during the fruit ripening process. The post-harvest process is the most important step in the breakdown of sugar compounds in coffee cherries, which is caused by the presence of fermentation played by microbes.

The roasting process also has a major influence on the presence of sugar because the heat will produce a Maillard reaction at phase I caramelization that occurred at 170-200^{o}C and changes proteins into amino acids and simple carbohydrates into monosaccharides, glucose, and sugar. The low molecular weight sugar content, sucrose is the main sugar in unripe coffee beans and its concentration is generally 4 to 9% and equivalent to 50 times greater than the content of fructose and glucose. (Bertuzzi et al., 2020).

d. ***Zinc (mg/kg)***

Coffee grounds are susceptible to heavy metal contamination that can occur due to improper processing. One of the most common heavy metal contaminations that have the potential to impact human health is zinc (Zn). Zinc compounds (Zn) can function as toxins if consumed by the human body in excess. Based on the Indonesian National Standard (SNI), the permissible content of zinc (Zn) in coffee grounds is 40 mg/kg. Based on the results of the data on the levels of zinc (Zn) contained in unpeeled coffee grounds, it has met the established SNI standards. This comes from the production process, one of which is the equipment used. Zinc (Zn) can move from one place and contaminate food products through the air (aerosol).

Microbiological characteristics powder of the dampit unpeeled robusta coffee

The results of the analysis showed the presence of yeast and mold colonies in coffee samples samples did not find any contamination of yeast and mold colonies. This was caused by the processing used and of course, the clean conditions applied. Yeasts and molds are aerobic microbes and can grow well in acidic conditions with a temperature range of 25-30^{o}C, but in the high-temperature roasting process there is a very large decrease in colonies, but there are some yeasts and molds that can be thermophilic.

According to Rasyidah (2018), coffee is an object that is easily damaged by various organisms, because it contains nutrients needed by organisms to grow, especially mold because coffee powder products have a fairly high-water content. In addition to the water content that affects mold contamination in coffee, packaging selection can also affect the growth of mold because of the ability to withstand the presence of oxygen needed by the fungus to grow and the ability of the packaging to maintain moisture.

Sensory evaluation of the dampit unpeeled robusta coffee drink

a. ***Flavor intensity***

The intensity of taste based on the 4 parameters given including sweet, bitter, sour and grassy shows the dominant taste felt by the correspondent, such as bitter taste with an average value of 3 (bitter taste). The highest intensity of bitter taste was found in samples of commercial powder brewed with V60 with a ratio of 1:7 of 3,463 and the lowest intensity of bitterness was found in samples of dried ripe pickled coffee powder with a ratio of 1:7 (Figure 1). French press brewing ratio of 2,861. The dominant coffee taste is bitter, but it also depends on the type of coffee used. The bitter taste in coffee is produced by the caffeine compounds found in brewed coffee (Budi et al., 2020). The intensity of taste in this study shows that respondents are more likely to feel a bitter taste that is more prominent than other flavors.

b. ***Preferences test***

The level of preference based on the 4 parameters given including sweet, bitter, sour, and grassy shows the dominant taste favored by the correspondent, such as sweet taste with an average value of 3 (sweet taste). The results of the sweetness correspondent preference level obtained have a value between 3,037 to 2,102 (Figure 2). The highest level of sweetness was found in the sun-dried French press brewing sample with a 1:7 ratio of 3,037 and the lowest sweetness level was found in commercial coffee brewed V60 with a 1:7 ratio of 2,102. Sweet taste can be produced from the reaction of some carbohydrate content.

When brewed using hot water, more sugar in coffee can be extracted so that it can cause higher Brix levels (Nurhayati, 2017). The level of preference in this study shows that respondents are more likely to like sweet tastes.

Analysis of volatile compounds with GC-MS

Compounds detected with % relative area (> 5%) in the analysis results for unpeeled coffee grounds with the given treatment can be seen in Figure. 3. Results Compounds found in the GC-MS analysis contained four dominant compounds present in brewed coffee. not peeled by sun drying and oven drying. The volatile compounds are 2-Aminosuccinonitrile, 5-hexenenitrile, 2-methyl-, ethyleneiminoacetonitrile, and 4-penten-1-ol, 3-methyl-. Ethyleniminoacetonitryl compound is a phytochemical compound that was also discovered by previous researchers, such as Enemor & Chinenye, (2019) in Watermelon Seeds (Citrullus lanatus). Ethyleneminoacetonitrile plays a role in bioactive compounds that encourage various biological activities in physiological systems such as antimicrobial, antioxidant, and anti-inflammatory.

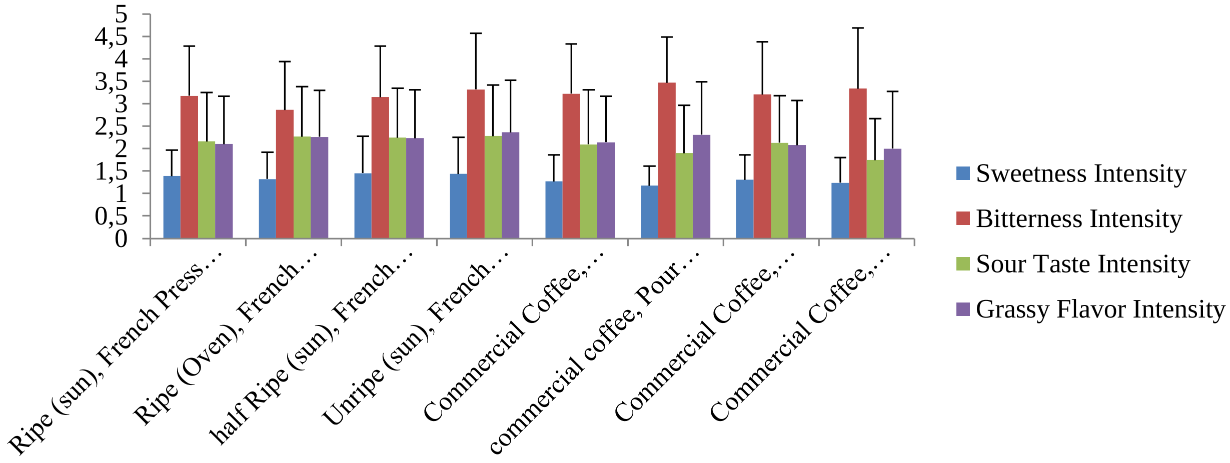


Figure 1. Flavor intensity of unpeleed robusta Dampit from several brewed techniques

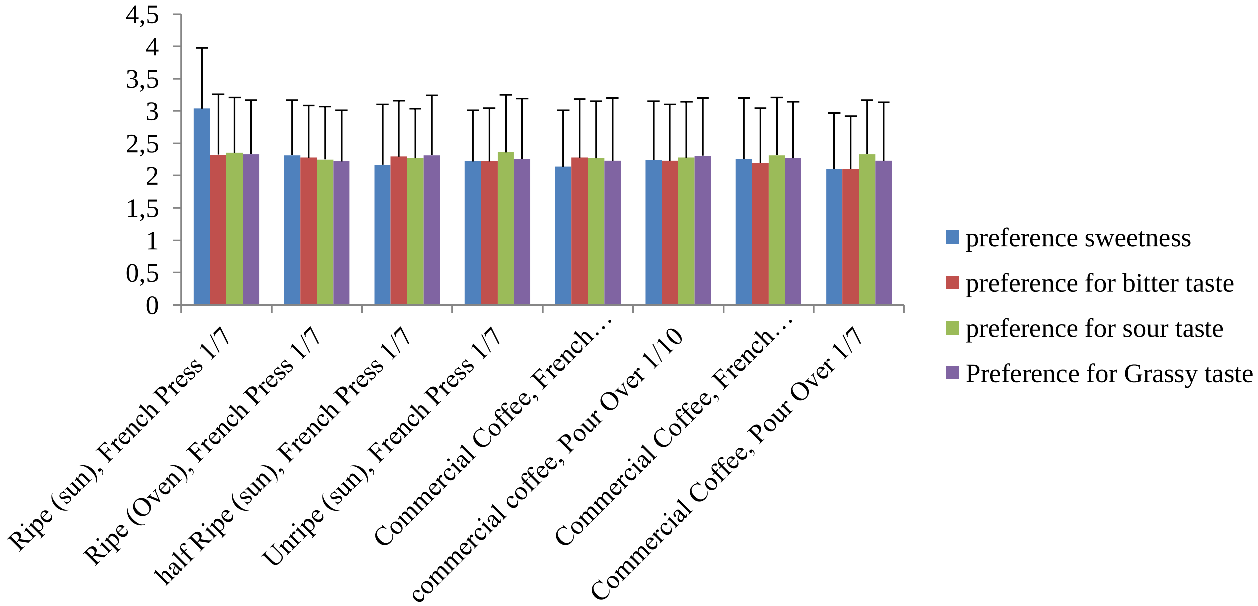
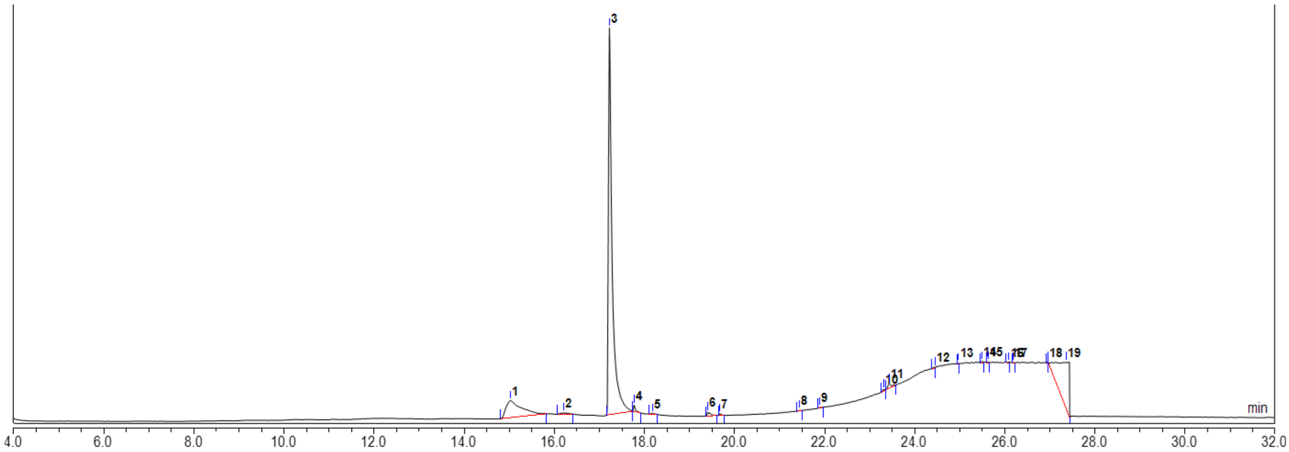


Figure 2. Preferences of unpeeled robusta Dampit from several brewed techniques



Sample	Hit# 1	Hit# 2	Hit# 3	Ret.Time (min)	Real. Area (%)
Ripe Sun Drying	2-Aminosuccinonitrile	5-Hexenenitrile, 2-methyl-	4-Penten-1-ol, 3-methyl-	17.21	74.62
Half-Ripe Sun drying	Ethyleniminoacetonitryl	5-Hexenenitrile, 2-methyl-	2-Aminosuccinonitrile	17.21	74.81
Unripe Sun Drying	2-Aminosuccinonitrile	4-Penten-1-ol, 3-methyl-	Ethyleniminoacetonitryl	17.21	89.36
Ripe Oven Drying	2-Aminosuccinonitrile	4-Penten-1-ol, 3-methyl-	5-Hexenenitrile, 2-methyl-	17.21	65.75
Commercial Coffee	Caffeine	1,4-Dimethyl-4,5,7,8-tetrahydroimidazo-[4,5-E]-1,4-diazepine-5,8(6H)-dione	6-Amino-1,3-dimethyl-1,6-dihydro-pyrrolo[3,4-d]pyrimidine-2,4-dione	17.22	63.11

Figure 3. GC-MS Chromatogram of Typical Unpeeled Coffee (E).

2-Aminosuccinonitrile is an amino acid compound whose flavor-active peptide derivative belongs to the amino acid succinyl or lactyl from the conversion pathway to aspartic acid (Hudson et al., 2008). These amino acid compounds give the umami taste and bitter taste. Based on the explanation another study by Zhao et al., (2016), stated that the active taste peptides derived from proteolysis mainly gave umami or bitter taste. The compound 5-hexenenitrile, 2-methyl- has another name, such as 2-Methyl-5-hexennitrile which is a derivative compound of the trifluoromethyl compound synthesis process. Further elaboration on the occurrence of 5-hexennitrile trifunctionalization triggered by photoredox-catalyzed trifluoromethyl radicals through cyano-group migration.

Based on previous research by Hashimoto, (2021) trifluoromethyl compounds are synthetic derivatives of sweet compounds, which include the use of photoaffinity labeling of diazirin-based derivatives to describe sweet taste chemoreceptors. The compound 4-penten-1-ol, 3-methyl- has another name, such as 3-Methyl-4-penten-1-ol which plays a role in the aroma of a food product. Data analysis is supported by previous research by Dara et al., (2016), who explained that volatile compounds released from traditional Asian rice contain 3-Methyl-4-penten-1-ol compounds which are thought to be correlated with a sweet aroma.

Conclusion

Acceptance rates and correspondent preferences provide different data results for each treatment. Significantly brewed coffee is found in sun-dried ripe options with a preference for sweetness in french-press brewing. Volatile compounds according to Gas Chromatography-Mass Spectrometry (GC-MS) have a strong correlation in increasing the sensory attributes of sweetness due to the presence of 5-hexennitrile, 2-methyl- and 4-penten-1-ol, 3-methyl-compounds. Further research can be carried out on one of the specific compounds in unpeeled coffee brewing and the right brewing method to improve coffee quality skinless coffee.

Declarations

Conflict of interests The authors declare no competing interests.

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