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Analysis of Caffeine Levels In The Beverages of Roasted Arabica CoffeeBalango In Solok Selatan With The Method of Spectroscopic

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Abstract. Research has been conducted on the analysis of caffeine levels in the beverages of roasted Arabica coffee ***balango*** using the spectroscopic method. The research was conducted in Research and Testing Laboratories (RTL) Gajah Mada University in November 2019. Samples of arabica coffee were taken from Solok Selatan Regency, which was processed using the process of fully washed and roasted using a ***soil cauldron*** or ***Balango*** in ***Solok Selatan***. This successfully proved that the surface area of the coffee powder determined the amount of dissolved caffeine level in boiling water. The concentration of caffeine in *original coffee powders, fine, medium, andcoarse* in a row are: 35.03%; 17.67%; 1.31%; and 0.69%.

Key word: coffee, balango, caffeine

1. Background

Broadly, the processing of coffee beans consists of three stages, namely the process of roasting, grinding, and brewing. The roasting process plays a role in the formation of compounds and flavor with heat treatment. Roasting time is determined on the basis of the color of roasted coffee beans or often called the degree of roasting. The longer the time of the roasting, the color of roasted coffee beans approaching dark brown blackish. The grinding process aims to minimize the particle size of coffee beans. Taste-forming compounds and fresheners are easier to dissolve in the water when the particle size of the coffee beans is minimized[1].The brewing process is the stage of the extraction process of aroma and flavor compounds by hot water. Along with the increasing popularity of coffee, the brewing method used is also growing depending on the culture, social context, and personal preference of consumers. *Febryand's research (2016*) explains that particle size and brewing techniques affect the sensory attributes of coffee, but the research is still limited to one-shop standards. Particle size and brewing methods are thought to have an influence on multisensory perception. Multisensory perception is a perception of a food product involving various factors, including the human senses, the intrinsic nature of food, the atmosphere, the equipment and so forth that significantly affects the behavioral response, Hedonic, preference, as well as sensory perception of food or drink [3].

Research on compounds in coffee by roasting and customary serving has been done a lot. The results show that the temperature and the length of roasting are very influential in the type of compounds produced from this thermal process. The roasting process is one of the important stages that produce thermal degradation compounds due to decaffeination, but currently still a bit of data about how the right roasting process to produce quality coffee products. In addition, the right selection of the diameter of the coffee powder is very important in determining the quality and taste of coffee because the extensive surface area of the coffee powder will affect the production rate of the thermal degradative compounds, the unique flavor of a coffee drink maker. The manufacture of ground coffee is widely done by farmers, retailer merchants, small industries, and factories. The making of ground coffee by farmers is usually only done traditionally with simple tools. The results are usually only privately consumed or to be sold when there is an order. While the making of ground coffee by the factory is usually done in a modern style with a large scale using the roasters.

The Coffee roasting until now still use much standard equipment traditionally, one of them the coffee rosting performed by the community *in Solok Selatan*, BukittinggiCity. Using a soil cauldron or called *Balango* and the mixing also uses human force (hand) and use firewood as fuel. It is a culture that remains preserved until now because the coffee doers in *Solok Selatan* still receive many orders from consumers. It is becoming a belief that the *Balango* roasted coffee in Solok Selatan is still a refreshing selection of drinks by many people.Coffee drinks have a unique flavor, such as a mixture of sour and bitter flavors dominantly. This flavor makes coffee lovers have their own sensations that can change the mood. Scientifically according to Blumberg (2010), the uniqueness of this flavor is influenced by the type of alkaloid compounds of caffeine, trigonelline, and chlorogenic acids [3]. Furthermore, according to Farah (2006) The main compounds of a bitter taste, chlorogenic acid and its derivatives, which are abundant when coffee beans are still green/fresh will be degraded during the process of roasting and brewing becoming compounds of caveat acid, Lactona, and other phenol compounds [4].

Coffee is known as a drink that has high-rated caffeine content in it [1]. Caffeine is one of the many types of alkaloids found in tea leaves (Camellia Sinensis), coffee beans (Coffea arabica), and cocoa seed (Theobroma cacao). Caffeine has a clinically beneficial pharmacological effect, such as neurostimulators, with effects of relieving fatigue, hunger, and drowsiness, increasing concentration power, improving brain work, mental mood as well as strengthening heart contractions. Excessive consumption of coffee can cause heart-pounding, stomach disorders, hands shaking, restlessness, diminished memory, and sleepless sleep [5].

Previous research focuses more on the proof of chlorogenic acid compounds as a key compound in determining the quality of coffee, antioxidants, variations in the extraction technique by the number of extracted compounds, and the influence of the cooking parameters to the Transformation of its compounds. On the other hand, the size parameter of the coffee powder also determines the magnitude of the concentration of the extracted chlorogenic acid compounds but still no one to do the research. Caffeine is the most important compound in coffee. Caffeine serves as an element of flavor and aroma in coffee beans. The caffeine content of the raw beans of arabica coffee is lower than robusta coffee raw beans, the caffeine content of robusta coffee is about 2.2%, and Arabica is about 1.2% [2].

Based on the above problems, special research on the determining analysis compounds of the unique taste on the Roasting Arabica Coffee Balango need to be done to lift local wisdom of the community of BukikApitBukittinggi city to the scientific territory. In this study, the modified variable is the temperature and the length of the brewing while the fixed variable is the diameter of the coffee powder and the percolation technique for the Roasted Arabica Coffee ***Balango*** dish. This research will determine the type of compound and its concentration due to the modification of the diameter of the coffee powder using the TLC method and UV-Vis spectrophotometry. Furthermore, Roasted Arabica coffee ***Balango***with several variable modifications will be organoleptically analyzed by the Q-grader by filling out the assessment form and the questionnaire provided. In the end, the characteristic physicochemical properties of the Roasted Arabica Coffee ***Balango*** can be determined so that the quality of the presentation of Roasted Arabica Coffee ***Balango*** can be definitely controlled so that it will enhance the love of coffee lovers.

2. Methods

The research was conducted in Research and Testing Laboratories (RTL) Gajah Mada University in November 2019. The tools and materials used in this research include Arabica coffee from Solok Selatan Regency with an optimal average diameter that has been determined, clean water, micrometric sieve, thermometer, glass and Pisin, paper indicator, straw, glass Square, camera, and ANOVA. In addition, caffeine and standard acrylamides were purchased from Sigma Chemical Co. (St. Louis, MO, EUA). Tanin and standard chlorogenic acid were purchased from Aladdin Chemistry Co., Ltd. (Shanghai, China). Trigonelline standard is purchased from Lvyuan Biochemical Co., Ltd. (Shanghai, China). All reagents are pro-analyst materials, while HPLC reagents are LC grade. Ultrapure Water is purchased from Milli-Q System (Millipore Corp., Milford, MA, USA). The motion phase is filtered with HAWP membranes and HVWP membranes for organic solvents and solutions (diameter 47 mm and pore size 0.45 mm, Millipore Corp., Milford, MA, USA).

It is determined and measured the samples of the diameter of the coffee powder that has been roasted and ground. Measurements are done in a micrometric way. Micromeritic is usually interpreted as a science and technology of small particles. Particle size can be expressed in various ways, such as average diameter size, average surface area extension size, average volume, and so forth. In this research, the particle size is the average diameter size. Particle measurement from powder based on residual weighing left in each sieve is to pass the sieve on the level of the low mesh number to a high mesh number driven by the vibratory machine with a certain time and speed. Caffeine extraction starts by taking two tablespoons of fine coffee powder, then inserted into the baker glass, and added 150 mL of hot arcades (90

^{o}C) while stirring for ± 10 seconds. After 2 minutes, a hot coffee solution is filtered using the Buchner funnel and filtrate accommodated in the Erlenmeyer.

The filtrate is inserted into a separating funnel and added 1.5 grams of calcium carbonate (CaCO3 or Na2CO3), shaken so that it is extracted three times, each with an addition of 25 mL of chloroform. The lower layer is taken, then the extract (chloroform phase) is evaporated with the evaporator rotary to chloroform. The procedure is repeated for each sample of the other three types of coffee powders. Analysis of caffeine levels was conducted with UV-Vis spectrophotometers at 276 nm. The four samples were carefully weighed with a digital scale with a mass of 0.1 g. into each added ethanol (96%) As much as 1 mL then stir until dissolved perfectly. The resulting mixture of each was administered as much as 0.1; 0.2 and 2 Ml in Silica gel plate 60 F254. Put it in a chamber that has saturated phases of the motion of ethyl acetate-methanol-water (100:113,5:10), relating to the limit, remove and dry. The dry Plate is measured each absorption at a wavelength of 272 nm with Rf: 0.67. The same treatment is done on positive control, which is caffeine standard.

3. Results and Discussion

3.1. Coffee Powder Diameter

The coffee powder has a variety of diameters, namely coarse, medium, fine, and original. Coarse is a very coarse size coffee powder (has a large diameter), this type of coffee powder is often used in French Press and Vietnam Drip. Medium is the size of coffee powder that is relatively moderate (not too medium and not too smooth)—for fine size, usually used on the method of coffee drops or drip Methode, except for Vietnamese Drip. Fine is a small/delicate relative size, usually used in an Espresso machine. Coffee powder size is also ideal for the type of tubruk (slammed) coffee presentation. Original is a mixture with a proportional comparison between fine, medium, and coarse.

The type of coffee that is often used in making Arabica coffee ***Balango*** is a type of arabica. Arabica coffee has a variety of flavors. They are ranging from soft sweetness to strong and sharp flavor. The acidity of Arabica coffee is also higher, which indicates that Arabica coffee is indeed a coffee with high quality. Before being roasted using Balango, arabica coffee has a scent like fruit. After being roasted, arabica coffee has a scent like fruit, beans with sour flavor, and sweet. Arabica coffee beans have a slightly larger shape and an oval. The content of lipid and sugar in arabica coffee is much more than Robusta coffee. Arabica coffee has a more lipid content of 60% than Robusta, and the Arabica coffee sugar content is almost twice than Robusta. Sugar content in coffee is important because the decomposition of sugar during the roasted process can increase the level of the coffee acidity flavor.

Based on the theory of the sample surface area affecting the reaction rate, the calculations in this study proved that the larger the surface area, then the number of dissolved caffeine compounds would be greater. The interesting thing happens on the original type of coffee sample, which is a mixture with a proportional comparison between fine, medium, and coarse has the largest concentration in dissolving with boiling water. This is in line with the results of organoleptic testing, which shows that Q-grader prefers the original type of coffee sample.

The grinding process in coffee processing aims to minimize the particle size of coffee beans so that the physical properties change. Ground coffee granules have a relatively large surface area than if in the whole state. Thus, the flavor-forming compounds and the freshener compounds are easily soluble in brewing water [1]. In the grinding process occurs the opening or dismantling of the inside of the coffee beans so that the extraction process runs more optimally. Commonly used particle sizes are coarse, medium, and fine. According to Febryana (2016), determination in the grinding of roasted coffee beans is influenced by the use of brewing methods to be used. The use of fine size is used for a shorter extraction process, while the rougher usage for the brewing method is a longer extraction process. The particle size, according to *Sharma (2013)*, is an important physical trait of food products that are tangible powder. It is reinforced by *Engelen (2004)* that the particle size affects sensory perception. Basically, the process of brewing coffee is an extraction process in which the result of the coffee brew is strongly influenced by the particle size and particle surface area that has contact with the solvent. Table 1 is presented with the most suitable particle size and brewing technic, according to Petracco [6].

Table 1. Particle size and appropriate brewing technique

Grind Size	Ideal Brewing Method
coarse	Plunger Pot
	French press
	Percolator
	Vacuum coffee pot (siphon)
Medium	Drip coffee makers with flat bottom filters (BUNN, Bloomfield, etc.)
Fine	Drip coffee makers with cone-shaped filters (KRUPS, Cuisinart, etc.)
	Espresso Moka pots
Extra Fine	Espresso machines – pump
	Espresso machines – steam
Turkish	Ibrik

*3.2. **Water Temperature Coffee Brewing and The range time to drink Coffee***

Water temperature is very important in the extraction process (flavor expenditure on the coffee powder). The water temperature of brewing and the length of brewing have a real impact on the chemical content levels (caffeine and polyphenols). Optimum temperature coffee brewing is 90 ^{o}C, and 100 ^{o}C, with a solvent concentration of 100%, obtained a caffeine rate increase of 0.66% per hour. According to the National Coffee Association, the proper temperature in making the coffee is 90-96 ^{o}C. If the water temperature to brew the coffee is too hot, then the coffee is too bitter. Whereas if the water temperature is too cold, then the coffee will taste sour and not strong taste. The longer the brewed coffee is left, the more acid is being released. Excess acid can cause a sense of heat in the stomach, indigestion, and can trigger erosion in the tooth enamel. Some research suggests that the coffee is taken 20 minutes after brewed to obtain maximum benefit from the resulted antioxidant

.

The brewing process is the process of coffee extraction by hot water. According to *Lingle (2011*), Broadly, there are three processes that occur during brewing, namely wetting, extraction, and hydrolysis [7]. Wetting is the process by which water is absorbed by the coffee powder. The absorption process is influenced by particle size and shape, initial humidity, porosity, gas solubility, pressure, and particle swelling [8]. After the coffee powder has contact with water, the volatile components and gas will evaporate while the aroma component will be extracted from the coffee and dissolve with the brewing water. At any given time, the extraction process will be optimal, and the hydrolysis reaction occurs [9].

Critical factors to note in the selection of brewing techniques is the length of time the water has direct contact with the ground coffee, the temperature of water used and the pressure for coffee brewing. Preparation of filtration of powder brewed coffee will affect the composition of the extracted coffee. Typically, water-soluble components include chlorogenic acid, caffeine, nicotinic acid, melanoidin compounds, and volatile hydrophilic compounds to be extracted higher when using temperature and high pressure [10].In-depth study of temperature parameters and Roasting time and Arabica coffee brewing against the degradation of the bitter taste compound has been done by *Blumberg et al 2010*. The study mentioned that the degradation of chlorogenic acid and cafeat occurred during the thermal process in the processing and serving of coffee beans. The intensity of bitter taste is directly proportional to the timing function caused by the increasing concentration of the compound result of degradation when processing time and presentation lasts long. This research also shows that the derivative compounds of quinine and catechols are closely related to the increasingly bitter coffee drink that is affirmed by sensory/organoleptic studies. This study does not discuss the size parameters of coffee powder because the coffee powder used is the same, so that the effect of the size of coffee powder parameters against the concentration of bitter taste compounds has not been explained.

Factors that have been researched during this time and related to the emergence of bitter taste in coffee, such as temperature and length of roasting, the type of roasting technique, temperature and length of brewing, and the type of brewing technique (extraction). The process of decaffeination that is practiced in the roasting process causes chlorogenic acid to undergo a reaction. Maillard and Strecker produce derivative compounds of quinidine and catechols and other phenolics that enhance the bitter taste of coffee drinks. There are other interesting physical variables to be examined that affect the rate of release of the bitter coffee compound i.e., the size of the coffee powder. Blumberg and friends. (2010) only describes the temperature factor and the length of roasting against the rate of release of the bitter taste compound but does not consider the surface area of the coffee beans extracted. This encourages a study that focuses on examining the impact of the variable diameter coffee powder that is brewed against the rate of release of the compound.

3.3. Caffeine Concentrations in Arabica Coffee Balango

The results obtained that the standard caffeine concentration: 0.0105 g/10 mL. Through UV-vis spectrometry, the caffeine levels in the sample can be determined and presented in the following table 1:

Table 1. Data on caffeine concentrations in Arabica Coffee Balango samples

Name ofsample	*n*	Total of Spot Sample (μg)	Area	Caffeine in the sample (μg)	Caffeine level (%)	Avrg (%)
Fine	1	3,79	10391,4	0,6798	17,921	17,67
	2	3,79	10092,3	0,6599	17,431	
Original	1	0,62	5907,1	0,3543	36,885	35,03

	2	0,62	5977,6	0,3511	33,235	
Medium	1	64,58	11893,3	0,8097	1,279	1,31
	2	64,58	12376,3	0,8586	1,348	
Coarse	1	66,62	8892,9	0,5389	0,821	0,69
	2	66,62	9208,3	0,5687	0,854	

The most important compound in coffee is caffeine. Caffeine can react with acids, bases, and heavy metals in acids. Caffeine is synthesized in the pericarp. The caffeine contained in roasted coffee has a rate or amount of 85 mg/5 oz, in instant coffee 60 mg/5 oz, and in decaffeinated Coffee 3 mg/5 oz[10]. According to Muchtadi et al., (2010), Caffeine can be soluble in water, has a fragrant scent but tastes very bitter [11]. Caffeine is a weak mono-acidic base and can split with the evaporation of water. With acids, caffeine will react and form an unstable salt. The reaction with bases will form a stable salt. Caffeine easily degrades with alkaline heat forming caffeine

In the process of roasting, a small portion of caffeine will evaporate and form other components, namely acetone, furfural, ammonia, trimethylamine, formic acid, and acetic acid. Caffeine in coffee is a free compound, as well as in combination with Chlorogenic as a chlorogenic potassium-caffeine compound. Roasted coffee beans can be directly packaged. The packaging is done with paper bags when coffee is separated from special outlets and directly used by consumers. Better storage place, as well as vacuum packaging, is needed to prevent deterioration oxidative if the coffee does not pass the special outlet. Currently used vacuum packaging of cans capable of withstanding the pressure formed or using a pouch that can release but receive oxygen [12]

According to Nascimento, et al. (2015), various studies have proved that both fresh arabica and robusta coffee, as well as the results of roasting, contain chlorogenic acid compounds, caffeine, trigonelline, nicotinic acid and sucrose, sugar, lipid, triacylglycerol, vitamins, alkaloids, Volatile compounds, and metals. Studies of volatile compounds have shown that the type of compounds that determine the aroma of coffee is influenced by the geographic region of growth. In addition to these compounds, laconic compounds, one derivative of chlorogenic acid, and other derivative compounds resulting from roasting is a key compound cause of bitter taste in coffee.

In-depth study of temperature parameters and Roasting time and Arabica coffee brewing against the degradation of the bitter taste compound has been done by Blumberg et al. (2010). The study mentioned that the degradation of chlorogenic acid and cafeat occurred during the thermal process in the processing and serving of coffee beans[1]. The intensity of bitter taste is directly proportional to the timing function caused by the increasing concentration of the compound result of degradation when processing time and presentation lasts long. Factors that have been researched during this time and related to the emergence of bitter taste in coffee, such as temperature and length of roasting, type of roasting technique, temperature and length of brewing, and type of brewing technique (extraction).

The process of decaffeination that is practiced in the roasting process causes chlorogenic acid to undergo a reaction of Maillard, and Strecker produces derivative compounds of quinidine and catechols and other phenolics that enhance the bitter taste of coffee drinks. There are other interesting physical variables to be examined that affect the rate of release of the bitter coffee compound i.e., the size of the coffee powder. Blumberg et al.

(2010) only describe the temperature factor and the length of roasting against the rate of release of the bitter taste compound but does not consider the surface area of the coffee beans extracted [1]. This encourages a study that focuses on examining the impact of the variable diameter coffee powder that is brewed against the rate of release of the compound.

Caffeine is a type of heterocyclic alkaloid in Methylxanthine, which, by definition, means a nitrogen-containing organic compound with a two-ring or two-cyclic structure. This naturally occurs in the plant as a secondary metabolite. Its function in plants is as a natural pesticide that cripples and kills insects that consume the plant. This substance is produced specifically in leaves, nuts, and fruits of more than 60 plants, including ordinary tea leaves (Camellia Sinensis), Cola Nut (cola acuminate), coffee (Coffea arabica), Cocoa beans. Caffeine has clinically beneficial pharmacological effects, such as stimulants of the central nervous arrangement, relaxation of muscles, especially smooth muscle bronchus, and cardiac muscle stimulants.

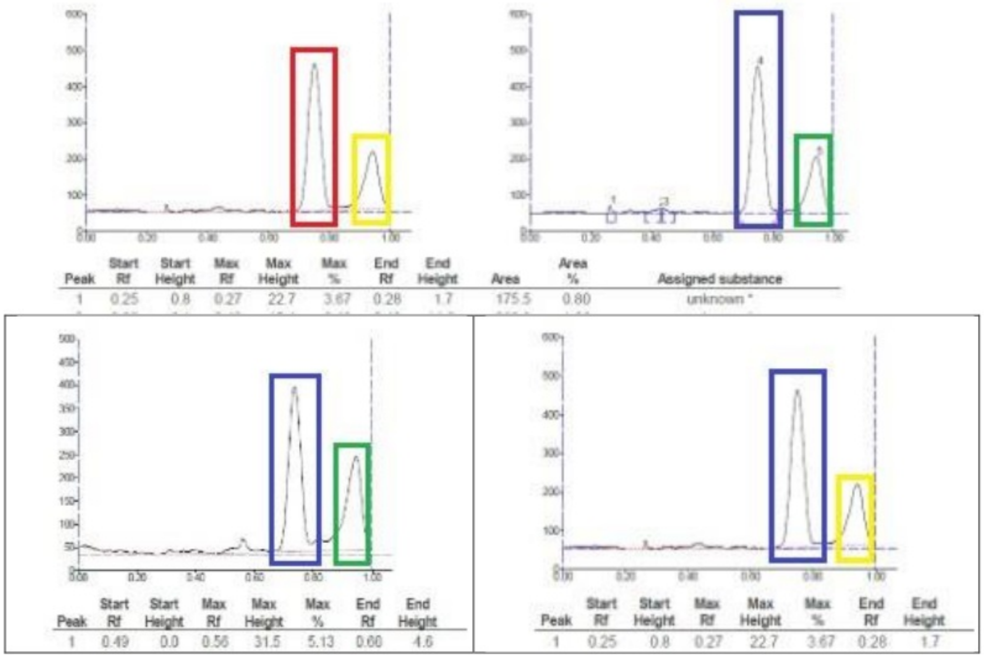
According to *Muchtadi and friends (2010)*, Caffeine can be soluble in water, has a fragrant scent but tastes very bitter. Caffeine is a weak mono-acidic base and can split with the evaporation of water. With acids, caffeine will react and form an unstable salt. The reaction with bases will form a stable salt. Caffeine easily decomposes with alkaline heat forming caffeine. Although the caffeine content in the coffee is only minimal, caffeine serves as a non-alcoholic stimulant compound, it tastes bitter and can be used for medications. These compounds can affect the central nervous system of the muscles and kidneys. At the central nervous system, caffeine is influential in preventing drowsiness, raising the capture of the senses, speeding up thinking, and alleviating fatigue. In the body, caffeine is antagonistic to the function of adenosine (a compound in the brain that can make a person quickly fall asleep) so as to make a person not sleepy after drinking coffee and have extra energy. Caffeine is perfectly absorbed in the digestive system within 30-60 minutes. The maximum effect that occurs in the brain appears within 2 hours so that caffeine does not take effect immediately and is very quickly removed from the brain. However, behind the positive side of caffeine in coffee, there is a negative impact of caffeine on the body. Recent observations show that there is a link between caffeine and Homocysteine plasma levels in the body rather than straight. High levels of caffeine intake will create an increase in homocysteine plasma concentrations. Increasing plasma concentrations will increase the risk of cardiovascular disease.

The mechanism of action of caffeine in nerve cells contributes to the effects of caffeine. Nerve cell activity is influenced by adenosine compounds. Adenosine is a nucleotide compound that functions to reduce nerve cell activity while sticking to the cell. Caffeine compounds also stick to the same receptors but do not slow down nerve cell activity instead of blocking adenosine to function. Caffeine binds to adenosine compounds in the brain so that the impact of brain activity increases and causes epinephrine or adrenaline-diseased hormones. The hormone increases heart rate, elevates blood pressure, increases blood feed to the muscles, and secretes glucose from the liver [13]. Caffeine is efficacious as a central and cardiotonic nerve stimulant. The working power as a central nervous stimulant of the pharmacological caffeine is very prominent, so it is commonly used as a central stimulant. Caffeine at low dosages is used as a matter of stamina and fatigue relief. Caffeine also has a positive inotrope effect on the heart, peripheral vasodilation, and Diuretics[14]. Caffeine in coffee is contained in the form of potassium-caffeine chlorogenic and chlorogenic acid. This bond will be detached by the presence of hot water so that caffeine can quickly be absorbed by the body. Chlorogenic acid is widely found in plants but compared to caffeine, with less physiological effects. Through the roasting, Trigonellin in coffee beans will be partially transformed into nicotinic acid (niacin), which is the type of vitamin in the B vitamin group*[16]*.

D. Curves of the results of analysis by chromatography

1. Fine

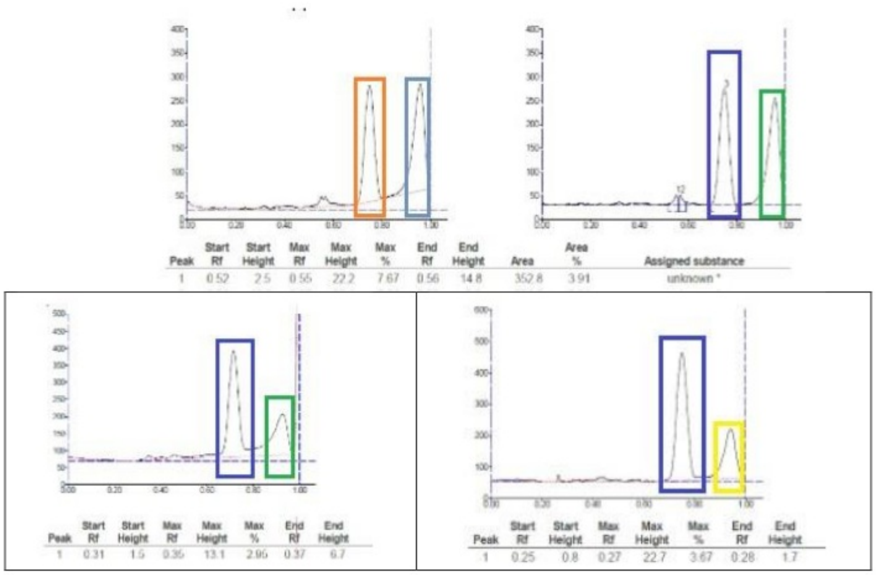
The results of the analysis of fine coffee grounds by thin-layer chromatography.



Picture 1. Results of Fine Coffee Powder Analysis with Thin Layer Chromatography

2. Original

The results of the original coffee powder analysis by thin-layer chromatography (TLC) are presented in the following graph.

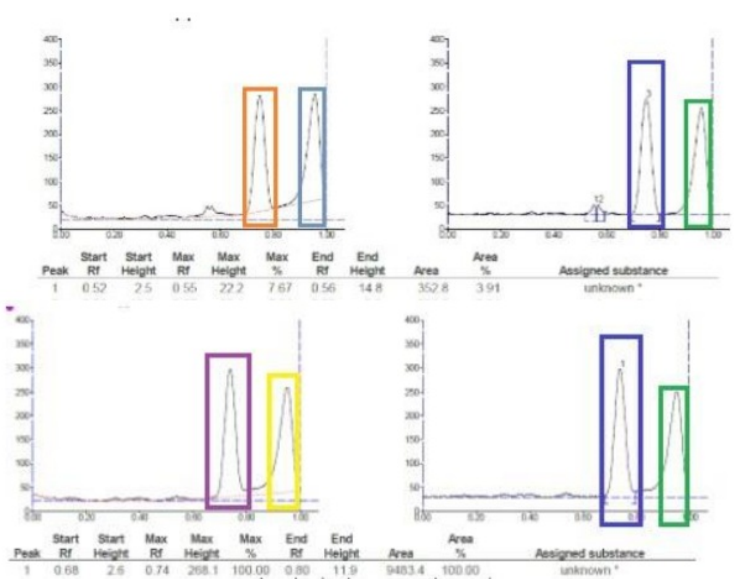


Picture 2. Results of Original Coffee Powder Analysis with Thin Layer Chromatography

Article Error

3.*Medium*

The results of the analysis of medium coffee powder by thin-layer chromatography (TLC) are presented in the following graph

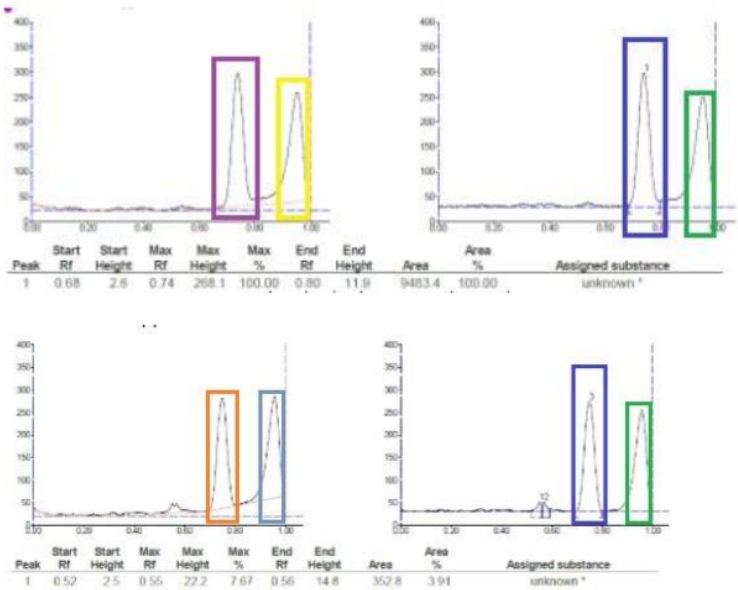


Picture 3. Results of Median Coffee Powder Analysis with Thin Layer Chromatography

Article Error

4. C*oarse*

The results of the analysis of coarse coffee powder by thin-layer chromatography (TLC) are presented in the following graph



Picture 4. Results of Coarse Coffee Powder Analysis with Thin Layer Chromatography

Based on the analysis on the table of caffeine levels of various types of coffee powder on coffee Arabica Roasted ***Balango***, different caffeine levels are allegedly caused by the magnitude of the grain diameter of the coffee powder. The amount of concentration is 35.03% for original coffee; 17.67% for fine coffee; 1.31% for medium coffee; and 0.69% for coffee coarse. Based on the theory of the sample surface area affecting the reaction rate, the calculations in this study proved that the larger the surface area, then the number of dissolved caffeine compounds would be greater. The interesting thing happens on the original type of coffee sample, which is a mixture with a proportional comparison between fine, medium, and coarse has the largest concentration in dissolving with boiling water. This is in line with the results of organoleptic testing, which indicates that respondents prefer the original type of coffee sample in the Arabica coffee Balango menu. Multisensory perception is a perception of a food product involving various factors, including the human senses, the intrinsic nature of food, the atmosphere, the equipment and so forth that significantly affects the behavioral response, Hedonic, preference, as well as sensory perception of food or drink [2].

4. Conclusion

This research successfully proves that the surface area of coffee powder determines the number of soluble caffeine levels in boiling water. Caffeine concentrations in the original, fine, medium and successive courses are 35.03%; 17.67%; 1.31%; and 0.69%. Advanced research is needed to test scientifically the optimum conditions, especially the temperature of water for the brewing so that the rate of caffeine is in accordance with the taste of society. The most important stage of coffee processing to the perception of the panelist in consuming coffee is the roasting process that plays a role in the formation of aroma and flavor, grinding process to minimize the size of coffee beans and the brewing process is the stage of extraction of aroma and flavor compounds.

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