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Analysis of Caffeine Levels in the Beverages of Roasted Arabica Coffee *Balango* in *Bukik Apik* 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 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 Balingka Agam Regency which was processed using the process of fully washed and roasted using a ***soil cauldron*** or ***Balango*** in ***Bukik Apik*** of Bukittinggi city. 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, and coarse* in a row are : 35.03%; 17.67%; 1.31%; and 0.69%.
Keywords: Coffee, Balango, Caffeine

1. Backround

Research on about compounds in coffee by roasting and customary serving have 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. Roasting process is one of the important stages that produces thermal degradation compounds due to de-caffeinitation 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 degradativ 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 privatel 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 many manual equipment traditionally, one of them the coffee rosting performed by the community ***in Bukik Apik***, Bukittinggi City.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 till now, because the coffee doers in ***Bukik Apik*** still receive a lot of orders from consumers. It is becoming a be f that the ***Balango*** roasted coffee in Bukik Apik 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 sensation that can change the mood. Scientifically according to Blumberg the uniqueness of this flavor is influenced by the type of alkaloid compounds of caffeine, trigonelina, and chlorogenic acids [1]. Furthermore, according to Farah the main compounds of 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 cafeat acid, Lactona, and other phenol compounds [2]. 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% [4].

Based on the above problems, special research on about 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 Bukik Apit Bukittinggi city to 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 modification of the diameter of the coffee powder using 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 Rosted Arabica Coffee ***Balango*** can be definitly 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 Balingka Agam Regency with an optimal average diameter that has been determined, clean water, micromeritic 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). Trigonelina 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 grinded. Measurements are done in a micromeritic way. Micromeritic is usually interpreted as a science and technology of small particles. Particle size can be expressed in various ways. Average diameter size, average surface area extention size, average volume and so on. 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 akuades (90 °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 3 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), elating 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, that is caffeine standard.

3. Results and Discussion

3.1. Coffee Powder Diameter

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 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. Ranging from soft sweetness to strong and sharp flavor. 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.

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). Water temperature of brewing and the lenght of brewing have a real impact on the chemical content levels (caffeine and polyphenols). optimum temperature coffee brewing is 90 °C and 100 °C, with a solvent concentration of 100% obtained a caffeine rate increase of 0.66% per hour. According to the National Coffee Association the best water temperature in making the coffee ideally is 90-96 °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. The 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.

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 of sample	*n*	Total of Spot Sample (µg)	Area	Cafeine in the sample (µg)	Cafeine level (%)	،vrg (%)
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. Caffeine contained in roasted coffee has a rate or amount of 85 mg/5 oz, in instant coffee 60 mg/5 oz, and in decafeinated Coffee 3 mg/5 oz[10]. According to Muchtadi Caffeine can be soluble in water, has a fragrant scent but tastes very bitter [6]. Caffeine is a weak mono-cidic base and can split with 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 cafeidine.

According to Nascimento the various studies have proved that both fresh arabica and robusta coffee as well as the results of roasting contain chlorogenic acid compounds, caffeine, trigonelin, 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 [5]. 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. 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 last 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 decafeination that is practiced in the roasting process causes chlorogenic acid to undergo a reaction of Maillard and Strecker produces derivative compounds of quinide and catecols and other phenolic 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. 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.

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 amount 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 Arabica coffee Balango menu.

4. Conclusions

This research successfully proves that the surface area of coffee powder determines the amount of soluble caffeine levels in boiling water. Caffeine concentrations in the original, fine, medium, and successive coarse 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.

References

[1] Blumberg S, Frank O, and Hoffman T 2010 Quantitative Studies on the Influence of the Bean Roasting Parameters and Hot Water Percolation on the Concentrations of Bitter Compounds in Coffee Brew *J. Agric. Food Chem*. **58**(6) 3720-3728

[2] Farah A, Paulis T D, Moreira D P, Trugo L C, and Martin P R 2006 Chlorogenic Acids and Lactones in Regular and Water-Decaffeinated Arabica Coffees *J. Agric. Food Chem.* **54**(2) 374-381.

[3] Ciptadi W and Nasution M Z 1985 *Coffee Processing. Faculty of Agricultural Technology* Bogor: Bogor Agricultural Institute

[4] Spinale and James J 1990 *Komoditi Kopi dan Peranannya Dalam Perekonomian Indonesia* Yogyakarta: Kanisius

[5] Santana C A M and Jose R N 2012 *Public Policies and Agriultural Investment in Brazil* FAO Report 39

[6] Muchtadi and Tien R 2010 *Food Sciences* Bandung: AlfaBeta

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