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Sensory and Chemical Changes of Cold and Hot Brew Arabica Coffee at Various Resting Time

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Abstract— Coffee is one of the most popular beverages which are rich in sensory attributes. What is the best time for brewing coffee after roasting is important question for consumer. In general, people do not directly brew coffee that has just been roasted. The chemical change which causes sensory changes still continues during the resting time. Enjoying coffee is about taste, everyone has different preferences. Some people prefer bitter coffee; some people like the sour taste and some others consume sweet coffee. Therefore, information about sensory and chemical profile is needed to give several options for consumer to choose their brewing method and brewing time before the coffee has decreased in sensory quality. This current study aims to know sensory and chemical changes of cold and hot brew Arabica coffee at various resting time. The materials were coffee beans Arabica Jawa Gunung Halu obtained from Cibeber, Sidangkerta Village, Mekarsari District, Bandung Regency, West Java. The roasted bean stored at various resting time (1, 3, 5, 7, and 9 days) than brewed in cold and hot brew methods. Sensory evaluation was conducted by 10 trained panelists using quantitative descriptive analysis (QDA). Furthermore, chemical analyses which were evaluated consist of the value of pH, brix and Total Dissolved Solid (TDS). The results showed that longer resting time followed by sensory characteristics changes on aroma, after taste, sweetness that is in line with chemical attributes change in Brix. Moreover color change in line with TDS change. While the different brewing techniques show that hot brew has higher value than cold brew in most all of parameters except Brix value.

Keywords— **chemical, coffee, panelists, resting time, sensory**

INTRODUCTION

Coffee is one of the most consumed beverage product around the world. The high demand of this product is due to its complexity of sensory properties and nutritional value that influenced from its chemical composition and how to process it (Caporaso et al, 2018). The quality of coffee is much related with national origins or geographical factors, cultural and social history (Toledo et al, 2017). Most important aspect in coffee quality can be seen from its sensory attribute such as aroma, flavor, taste, mouth feel etc (Sunarharum et al, 2014). This quality is highly influenced by many pre-harvest and post-harvest factors. Furthermore coffee processing technologies contribute to the change of physical, chemical and sensory attribute. Among these processes are fermentation, roasting, resting time or storage after roasting, grind size, serving temperature, extraction methods, grinding and brewing (Edzuan et al, 2015; Fuller and Rao, 2017).

As the last chains of coffee processing, brewing technique is crucial step to produce some chemical compound, physic-chemical and sensory properties a cup of coffee (Parenti et al, 2014). During the brewing process more than 800 volatile compounds of solid roasted coffee contact with water and soluble compound will be extracted (Jeon et al, 2017). Brewing time, typically of filter, water temperature and water pressure are process variables that plays major factors to extract antioxidant compound from coffee (Lopez et al, 2016; Rendon et al, 2017; Steen et al, 2017). There are several different brewing techniques have been studied to produce high quality coffee with various characteristics (Gloes et al, 2013). Brewing coffee by pouring hot water results drip coffee and brewing by cold water results cold brew coffee (Shin, 2017). Extraction using cold water improved shelf life, better retention of secondary metabolites, volatiles and gives positive effect for health (Lane et al, 2017). Otherwise, higher brewing temperature will followed by faster extraction rate of the water-soluble chemical components (Asiah et al, 2017).

To obtain specific sensory properties of coffee, roasted bean should be stored at certain time before brewing. During resting the reduction of CO_2 gas level may change and give significant effect on sensory quality of coffee (Dwiranti et al, 2019). Longer storage time will be followed by increase chlorogenic acid, decreasing of total phenolic content and caffeine content (So et al, 2014). Changes in chemical components will greatly affect the change in its sensory properties. Quality parameter of coffee products that can be directly perceived by consumers is sensory (Sunarharum et al, 2014).

It cannot be denied that consumer preferences and their willingness to pay strongly influenced by the sensory quality. However, studies focus on sensory and chemical properties of liquid hot and cold brew coffee at various resting time are still les information. Even though, it is needed for coffee businesses. Then, the data can be used to give consumers quality assurance that roasted coffee bean is still good quality after stored. Considering this condition, the objective of this research is the effect of the effect of different brewing methods for various resting time.

MATERIALS AND METHODS

A. *Material Preparation*

Coffee beans used in this research is Arabica Jawa Gunung Halu obtained from Cibeber, Sidangkerta Village, Mekarsari District, Bandung Regency, West Java. Green coffee beans were roasted at medium roast level. Then, roasted coffee beans package in airtight packaging in the form of aluminum foil with zipper lock, do not allowed to be exposed to direct sunlight and stored at room temperature (25^{O}C). The various resting time were 1, 3, 5, 7, and 9 days (Yeretzian et al., 2017). In those times, each roasted coffee beans were ground with ground size 20 mesh by Latina N600 grinder. The ground beans were brewed by Hario Mizudashi Coffee Pot. The ratio of coffee powder and cold water used is 1:10 (Dwiranti et al, 2019). Coffee powder was put into a filter tube and then poured cold water (4^{O}C) gradually until it steeps the coffee powder. Steeping results will be stored in the storage tube. Coffee powder steeped for 8 hours and stored in the refrigerator. For hot brewing hot water was brewed directly on the coffee grounds in glass cups up to reach the edge of the glass so that all coffee grounds are brewed equally. The ratio of coffee powder and cold water used is 1:15 (Asiah et al, 2017). Coffee brew waited for 4 minutes before evaluated.

B. *Sensory Analysis*

Sensory evaluation was carried out by 10 trained panelists (Kreuml et al, 2013). Sensory evaluation method used was quantitative descriptive analysis (QDA). Each panelist was given the same sample and the same size to evaluate basic coffee attributes such as aroma, taste, acidity, after taste, body, color, sweetness and bitterness. During the quantitative assessment, the panelist has the duty to judge the intensity of the specified attributes on a numeral ordinal 10-unit scale with the end values labeled as imperceptible and very intense.

Chemical Analysis

Chemical analyses evaluated in this research were the value of pH, brix and Total Dissolved Solid (TDS). The degree of acidity (pH) tested using a pH meter refer to Dwiranti et al, (2019); dip the electrode into the sample solution until the pH meter display shows a stable number.

Brix value represents the concentration of sugar from a liquid. This test was carried out using brix refractometer refer to Savitri et al (2017). The value of Total Dissolved Solid (TDS) was measured by TDS meter. This tool helps see solids dissolved in a coffee solution that cannot be seen by the naked eye. The use of this tool is only by dipping it into the sample solution with a depth of ± 5 cm then a digital number will appear on the tool display. Wait 2 to 3 minutes until the numbers obtained are stable. The sample solution is ensured to have a room temperature (25 ° C).

RESULTS AND DISCUSSIONS

Sensory and Chemical Changes of Cold and Hot Brew Arabica Coffee at Various Resting Time

The results of QDA test demonstrated differences value in the intensity of all evaluated sensory attributes in both cold and hot brewing methods at various resting time (Table 1). Results showed that different resting time caused sensory and chemical changes of cold and hot brew Arabica coffee. Sensory and chemical changes do not occur linearly with resting, where changes occur fluctuatively in most of parameters. Generally, sensory attributes of aroma, after taste, and sweetness increase with increasing storage time both cold and hot brew. The increasing of sweetness in line with rising of Brix value. Otherwise the color value goes down. This is also in line with decreasing of TDS value. Decreasing the TDS value can also reduce the aroma and taste during resting time that causes flavor and viscosity level becomes more fluid. The decreased TDS value shows that the coffee sample obtained medium body value, has a little pulp, and contains a bland taste.

During storage, roasted beans are susceptible to further chemical and physical changes that may greatly affect the sensory quality of coffee beverages (Kreuml et al, 2013). Water, air, and light levels affect the quality of the coffee beans to be brewed. The presence of this air also causes flavors in coffee beans to become volatile (Toci et al., 2013). At the resting time, the amount of CO_2 also continues to decrease or escape from the roasted coffee beans along with the release of bitter taste so that only leaves a sweet taste during brewing. Moreover storage changes in composition of lipids that may contribute to a loss of sensory quality of coffee beverages. Lipids can be hydrolyzed chemically or enzymatically and the rate at which these reactions occur depends on environmental and technological aspects, as well as availability of oxygen, moisture, temperature, and packaging material (Manzocco and Lagazio 2009).

Table1. Sensory and Chemical Changes of Cold and Hot Brew Arabica Coffee at Various Resting Time

Resting time (days)		0	1	3	5	7	9
Aroma	Hot	5.24	5.94	5.76	6.28	6.28	6.02

	Cold	6.13	5.30	6.20	6.35	5.85	5.45
Taste	Hot	5.82	5.98	6.54	6.41	6.34	6.23
	Cold	5.75	5.23	5.58	5.69	6.28	6.18
Acidity	Hot	5.17	5.14	5.73	4.52	7.16	5.92
	Cold	4.76	6.07	3.98	4.94	5.54	6.29
Aftertaste	Hot	3.22	3.50	4.02	3.71	2.85	2.41
	Cold	3.30	2.62	1.24	2.41	2.13	1.72
Body	Hot	5.47	4.89	5.31	5.26	4.97	4.82
	Cold	5.30	5.62	3.45	5.51	5.19	4.26
Color	Hot	5.64	5.48	5.67	5.76	6.00	5.98
	Cold	5.60	5.65	5.47	5.40	5.74	5.58
Sweetness	Hot	5.74	5.95	6.15	6.07	6.36	6.30
	Cold	4.28	4.69	6.02	5.81	4.24	5.33
Bitterness	Hot	2.82	2.60	3.27	3.93	2.86	2.40
	Cold	3.04	1.90	1.39	2.79	1.98	2.83
pH	Hot	4.70	4.72	4.74	4.75	4.83	4.85
	Cold	5.20	5.13	5.17	5.17	5.23	5.20
Brix	Hot	4.06	4.26	4.66	4.70	4.60	4.50
	Cold	4.07	4.13	3.97	4.00	4.07	4.07
TDS	Hot	113	113	115	114	114	114
	Cold	111	108	108	106	107	107

Sensory and Chemical Profile Comparison between Cold and Hot Brew Arabica Coffee

From Fig. 1 we can see that attributes of aroma, taste, acidity, after taste, body, color, and sweetness and bitterness hot brew higher than cold brew. From chemical parameters there is small difference in Brix and pH values between hot and cold brew coffees. pH is a poor measurement for the complex acid chemistry in both hot and cold brew coffee extracts. In general, these results suggest that cold and hot brew coffees are have almost similar in their acidity. However, cold brew coffee extracts were found have lower concentrations of acidic compounds and may be less chemically diverse than hot brew coffee extracts prepared from the same beans (Rao and Fuller, 2018). The sour taste detected in coffee brew comes from the acid content in coffee, which is from the carboxylic acid group in coffee beans including formic acid, acetic acid, oxalic acid, citric acid, lactic acid, malic acid, and quinic acid (Widyotomo et al., 2009).

Temperature affects the solubility and volatility of the coffee soluble component where coffee solubles dissolve best at an optimal temperature of 90-96 °C. The solubility of fructose in cold water is better than sucrose and glucose (Crestani et al., 2013). Sweet and caramel flavors and aromas are produced from total sugar and non-reducing sugar in coffee (Partelli et al., 2012). This is explaining way the Brix value of cold brew higher than hot brew and TDS value of cold brew less than hot brew. With more coffee solubles extracted, hot brew coffees are described as more full-bodied and flavorful when compared to cold brew. Furthermore, rising of volatility in higher temperatures causes releasing of aromatics compound (Sunarharum et al, 2014). Unlike hot brew, cold brew doesn't have the rich aromas that hot brewed coffee. However, since those oils remain cold through the cold brewing process, they're not volatile and keep stay in the cold brew coffee. So, when cold brew swallowed, those aromatic oils hit retro-nasal passages the brain interprets them as a truckload of vibrant floral flavors.

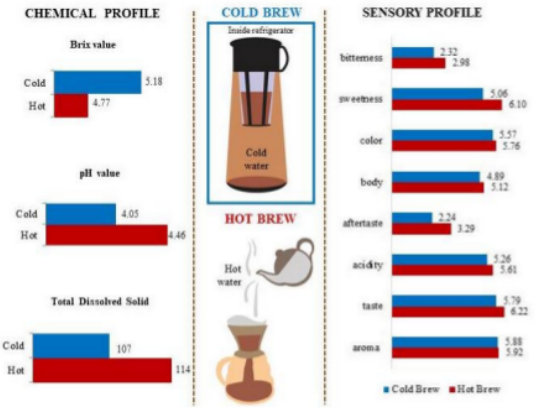

Fig.1 Average Value of Sensory and Chemical Profile between Cold and Hot Brew Arabica Coffee

CONCLUSIONS

It can be conclude that sensory and chemical attributes of cold and hot brew coffee products differ at various resting time. The longer resting time followed by significant sensory characteristics changes on aroma, after taste, sweetness and chemical attributes change in Brix and TDS. While the different brewing techniques show that hot brew has higher value than cold brew in most all of parameters except Brix value. Higher or smaller values are not absolute parameters to determine the best quality of coffee brewing. It is because the choice of using hot or cold brewing technique is influenced by many things such as personal preferences, weather, health condition, culture etc.

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