The Modification of Coffee Leaves Beverage (Air Kawa) Processing Through Enzymatic Oxidation

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Air kawa is a traditional beverage from coffee leaves in West Sumatera. Processed by dried and boiled the leaves. One method of processing to improved beverage flavor by performing enzymatic oxidation coffee leaves. Coffee leaves were processed by modification method to get Air Kawa beverage by oxidation enzymatic. The process includes the series of withering, milling / rolling, enzymatic oxidation, drying and brewing. In the process, coffee leaves were divided to two types, leaves in the top and first leaves from the top (p+1) and the second and third of leaves from the top (2+3). The dryer were divided to three types are cabinet dryer, roaster, and cabinet smoker. And brewed was performed with varied the drink to three concentrations, 0.5%, 1.0% and 1.5% (w/v). This study also determined the effect of type of leaves, type of dryer, and variation of concentrations to consumer acceptance. And also to evaluate tannin content in astringent taste and brown color, caffeine content in bitter taste, and pH in flavor of Air Kawa beverage that most favored by consumer. Air kawa most favored by consumers with high intensity of flavor, brown color and freshness and with low intensity of bitter and astringent taste. Leaves p + 1 are a leaves that can be accepted by consumers in the manufacture Air kawa. Roaster is a most acceptable to consumers. Concentration 0.5% (w/v) is acceptable consumers. Intensity the astringent taste and brown color is not only influenced by the tannin content. Intensity the bitter taste is not only influenced by caffeine content. Intensity of flavor is not only influenced by pH. PH ranged from 5.08 – 5.47. Caffeine content ranged from 94.50 – 139.22 ppm, tannins content of Air Kawa ranged from 106.80 – 385.73 ppm.

(Key words: Air Kawa, Coffee Leaves, Enzymatic Oxidation)

1. Introduction

Air Kawa is a beverage of coffee leaves. The drink is most popular in West Sumatera, Indonesia, as a traditional beverage. Made by drying the leaves over an open flame up to twelve hour and then boiled for two hours. According to the anonymous (2011), the color of Air Kawa is more similar to tea, but still has a coffee flavor with slightly astringent – bitter taste.

Bioactive compounds in water and ethanol extract of coffee leaves form of phenolics and tannins group. Whereas in the chloroform extract form of phenol and alkaloid group especially caffeine. Coffee leaves contain of alkaloids, saponins, flavonoids and polyphenols. Phenolic chlorogenic, caffeic acid, caffeine alkaloid, and some derivates are present in coffee leaves (magalhaes, et al, 2008). While the caffeine content in the *C. canephora* is 1417.32 ppm. Caffeine is synthesized in young coffee leaves which remain sequestered in the vacuole, but not entirely biosynthesis occurs in leaves (Aerts & Baumann, 1994; Fujimori & Ashihara, 1994; Ashihara, 2006). Only caffeine, theobromine, and xanthine, present in detected amounts when the leaves and top extract were analyzed by HPLC. Shoots and young coffee leaves contain the highest concentrations of caffeine with about as much as one-third were detected. According to Johnson and Peterson (1974), caffeine in a pure state has the form of white powder and hexagonal prism-shaped crystal. Caffeine is a compound with no smell,

taste bitter, and have toxic properties (Sievets and Desrosier, 1979). Presence of tannin in the diet can determine its taste. Astringent taste of the food is usually caused by tannins.

One method of processing to improved beverage flavor by performing enzymatic oxidation coffee leaves. According to Spiller (1988), oxidation process kept under a temperature 30 ^{o}C. At a temperature 15 – 20^{o}C, both to improve flavor.

The purposes of this study are to get Air Kawa processed through enzymatic oxidation, determined the effect of type of leaves, type of dryer, and variation of concentrations to consumer acceptance. And also to evaluate tannin content in astringent taste and brown color, caffeine content in bitter taste, and pH in flavor of Air Kawa beverage that most favored by consumer.

2. Material and Methods

a. *Materials*

Coffee leaves were divided into two types. Type p+1, leaves with on tops and first leaves from tops position. And the other type 2+3, leaves with on second and third position from tops. Coffee leaves picked from coffee plantation in the Pentingsari village, Cangkringan, Sleman. Preliminary research conducted to obtain the optimal process of withering and oxidation enzymatic for Air Kawa processing. Coffee leaves through a series of process. The series are withering, rolling, oxidation enzymatic processing, drying, and brewing.

b. *Experimental Design*

Selected three factor for this experiment are type of leaves (p+1 and 2+3), type of drier (cabinet drier, roaster, and cabinet smoker), and steeping concentration of Air Kawa (0.5%, 1.0% and 1.5% w/v).

Table 1. Variation of Air Kawa processing method

Type of leaves	*Type of drier*	*Steeping concentration of Air Kawa*
Type P+1	*Cabinet drier*	*0.5 % (w/v)*
		1.0 % (w/v)
		1.5 % (w/v)
	Roaster	*0.5 % (w/v)*
		1.0 % (w/v)
		1.5 % (w/v)
	Smoker	*0.5 % (w/v)*
		1.0 % (w/v)
		1.5 % (w/v)
Type 2+3	*Cabinet drier*	*0.5 % (w/v)*
		1.0 % (w/v)
		1.5 % (w/v)
	Roaster	*0.5 % (w/v)*
		1.0 % (w/v)
		1.5 % (w/v)
	Smoker	*0.5 % (w/v)*
		1.0 % (w/v)
		1.5 % (w/v)

Products were analyzed by sensory analysis, tannin, caffeine, pH analysis. Analysis of tannin use Rangana (1986) method and analysis of caffeine use AOAC.Official Method 962.13 – 1999, *Caffeine in Non Alcoholic Beverages.*

c. *Withering*

The temperature was at 29^{o}C, RH 76 %. The process was done during 20 h on one layer of leaves spread.

d. *Rolling*

Out of withering, the leaves will be rolled and use manual rolling machine (with screw grinder). Leaves rolled into the grinder. The rotation of milling is 40 rpm. Rolling performed at room temperature (28 – 30^{o}C).

e. *Enzymatic oxidation*

The condition of enzymatic oxidation process was at 23.5^{o}C, RH >85% during 30 min.

f. *Drying*

Drying performed until the condition of water content reaches 2.5 – 3.5 %. Leaves were not over burn, not occure case hardening and dried whole indicate completing drying.

Drying use cabinet drier performed at temperature 70 – 100^{o}C. Roaster run at 90 – 150 ^{o}C, rotate in 20 rpm. The smoker run at 100^{o}C. Smoke generated from wood.

g. *Brewing*

Use boiled water (100^{o}C) during 15 min to brewing dried leaves to make Air Kawa

3. Result and Discussion

a. Preference Level of Air Kawa Beverage in Differents Variations of Concentrations

Table 2. The most preferred concentration of Air Kawa by panelists

Treatment	Steeping concentration of Air Kawa % (w/v)
Leaves P+1, cabinet drier	0.5
Leaves P+1, roaster	0.5
Leaves P+1, smoker	0.5
Leaves 2+3, cabinet drier	1.0
Leaves 2+3, roaster	0.5
Leaves 2+3, smoker	1.0

Table 2. shows that in concentration 0.5 % (w/v), sample from leaves p+1 have been the most preferred Air Kawa. As for the leaves 2+3 required higher concentration to be the most preferred concentration (1.0 % w/v), except on the sample leaves 2+3,roaster. In 0.5 % (w/v), sample leaves 2+3, roaster has been the most preferred Air Kawa.

b. The Sensories Parameter Value on Variety of Treatments.

Oxidized polyphenol compounds may influence the sensory properties. Different leaves position may affect the different intensity of sensory properties. In his research, Rodrigues, et al (2008) states that the amount of phenols in young leaves of fruit crops is 174.0 mg / g and that no production plant is 186.5 mg / g, greater than the amount found in mature leaves of the observations made by Oliveira & Romeiro (1991) in Rodrigues, et al (2008), who also found a greater concentration of phenols in young leaves.

Tabel 3. The preferance Level and Intensity Value of Air Kawa on Variety of Treatments

Treatment	Preference Level					Intensity Value				
	Flavor *	Bitter taste*	Astringent taste*	Freshness *	Brown color*	Flavor**	Bitter taste**	Astringent taste**	Freshness**	Brown color**
Leaves p+1, cabinet drier	3.1^{ab}	2.35^{ab}	2.75^{a}	2.85^{a}	2.0^{a}	3.2^{a}	3.35^{ab}	3.0^{ab}	2.2^{ab}	2.05^{b}
Leaves p+1, roaster	3.45^{b}	2.65^{ab}	2.8^{a}	2.95^{a}	2.9^{b}	3.35^{ab}	2.85^{ab}	2.65^{a}	2.3^{ab}	2.1^{b}
Leaves p+1, smoker	3.4^{b}	2.7^{b}	2.8^{a}	3.0^{a}	1.85^{a}	3.0^{a}	3.05^{ab}	2.65^{a}	2.2^{ab}	1.4^{a}
Leaves 2+3, cabinet drier	3.0^{ab}	2.0^{a}	2.7^{a}	2.75^{a}	3.5^{c}	3.3^{a}	3.85^{c}	3.05^{ab}	2.0^{a}	3.2^{c}
Leaves 2+3, roaster	3.45^{b}	2.6^{ab}	2.95^{a}	3.05^{a}	1.9^{a}	3.5^{a}	2.6^{a}	2.8^{ab}	2.65^{b}	1.45^{a}
Leaves 2+3, smoker	2.6^{a}	2.15^{ab}	2.4^{a}	2.75^{a}	3.25^{c}	2.95^{a}	3.5^{bc}	3.5^{b}	1.85^{a}	2.55^{b}

Note: The superscript sign with the same letters are not on the same column indicate values significantly different (α = 5%)
Symbol "*" : samples were tested with hedonic test
Symbol "**" : samples were tested with scoring test
Preference level : 1. Dislike 2. Less like 3. Like 4. Very like 5. Very very like
Intensity Value
Flavor : 1. Not tasty, 2. Less tasty, 3. Tasty, 4. Very tasty, 5. Very very tasty
Bitter taste : 1. Not bitter, 2. Less bitter, 3. Bitter, 4, Very bitter, 5. Very very bitter
Astringent taste : 1. Not astringent, 2. Less astringent, 3. Astringent, 4. Very astringent, 5. Very very astringent
Freshness : 1. Not fresh, 2. Less fresh, 3. Fresh, 4. Very fresh, 5. Very very fresh
Brown color : 1. Very weak brown, 2. Weak brown, 3. Brown, 4. Strong brown, 5. Very strong brown

The higest intensity of flavor is the highest preference level of Air Kawa. The highest intensity of bitter taste is not the highest preference level of Air Kawa. The highest intensity of astringent taste is not the highest preference level of Air Kawa. The highest freshness intensity is the highest preference level of Air Kawa. The highest intensity of brown color is the highest preference level of Air Kawa.

c. Tannin, Caffein, pH Analysis

Table 4. Tannin content of intensity value of brown color and astringent taste, caffeine content of Intensity value of bitter taste and pH value of intensity value of flavor

Treatment	Intensity Value of		Tannin content (ppm)	Intensity Value of bitter taste	Caffeine content (ppm)	Intensity Value of Flavor	pH Value
	Brown color	Astringent taste					
Leaves p+1, cabinet drier	2.05^{b}	3.0^{ab}	385.73	3.35^{ab}	112.44	3.2^{a}	5.43
Leaves p+1, roaster	2.1^{b}	2.65^{a}	308.14	2.85^{ab}	139.22	3.35^{ab}	5.42
Leaves p+1, smoker	1.4^{a}	2.65^{a}	140.52	3.05^{ab}	94.50	3.0^{a}	5.18
Leaves 2+3, cabinet drier	3.2^{c}	3.05^{ab}	383.81	3.85^{c}	131.83	3.3^{a}	5.47
Leaves 2+3, roaster	1.45^{a}	2.8^{ab}	106.80	2.6^{a}	103.08	3.5^{a}	5.33
Leaves 2+3, smoker	2.55^{b}	3.5^{b}	263.60	3.5^{bc}	135.97	2.95^{a}	5.08

Note: The superscript sign with the same letters are not on the same column indicate values significantly different (α = 5%)

Shown in table 4. tannin content can not be attributed to the intensity of brown color and astringent taste of Air Kawa. Tannin content in Air Kawa ranged from 106.80 – 385.73 ppm. The lowest concentration of tannin varied to create astringent taste, depending on the solvent. In the water, tannins with concentration of 20 mg per 100 ml had aroused astringent taste. Burdock (2010) states that the threshold to feel the tannin is unknown.

One of the brown color-forming compound is tannin. However, the color brown can also be formed from the treatment process, such as the Maillard reaction. Maillard reaction is a reaction that occurs between the amino group of a free amino acid, peptide or protein chain residues, the carbonyl group of a carbohydrate when both are heated or stored for a long time. There are 3 lines melanoidin brown color formation in the Maillard reaction. First, through Amadori compounds are converted to 1,2- eneaminol and 2,3-enediol. Second, aldol condensation, which is an alternative path. Third, Strecker degradation is not directly form the pigment but provides a reducing compound essential for the formation of brown color (Eskin 1990).

The brown color is affected by the loss of chlorophyll in the leaves. The main reaction is the replacement of Mg^{2+} atom in chlorophyll by hydrogen under acidic conditions to form a peofitin. Next piropeofitin a and b as a result of degradation peofitin a and b can cause a brown color (Eskin 1990). Kim et al. (2003), examined changes in chlorophyll content of the flour dough containing spinach powder (Spinacea oleracea) are fried in soybean oil at a temperature of 160^{0C} for 1 minute and stored in glass bottles. After incubated at 60^{0C} in the dark for 12 days, there was a decrease of chlorophyll, while the content increased and then decreased peofitin. Besides peofitinitation, chlorophyllase endogenous enzymes capable transforming of chlorophyll to chlorophylide with the loss phytol group. The combination of work chlorophyllase and acid cause the loss of Mg 2 + and phytol group, thus forming peoforbida. It should be noted that all changes in chlorophyll reactions can take place by heat (Eskin 1990 in Francis 1996).

Burdock (2010) states that the trheshold for detection caffeine in water is 0.0095% (or 95 ppm) , in the liquid diet 0.0184% (or 184 ppm). In one study, the panelists could distinguish the solution with caffeine content 0.0058% (or 58 ppm) of control. Threshold to distinguish the caffeine solution with the control was 0005% and to differentiate bitterness is 0011%.

Bitter taste is not only influenced by caffeine compounds. These compounds contribute to forming a bitter taste, which is benzaldehid, hydrogen cyanide, triasetin, 2 - tridicenal, trietil citrate, thiamin hydrochloride (Burdock, 2010), picroretine.

Thus, caffeine content could not be attributed to the intensity of bitter taste in the Air Kawa. Caffeine content in the Air Kawa ranged from 94.50 - 139.22 ppm.

PH in the Air Kawa ranged from 5.08 – 5.47. Acid compounds can create the flavor of the foods. Acids in Air Kawa processing formed during withering. In withering, the protein will break down into volatile amino acids and enhance flavor.

4. Acknowladge

Product favored by consumers have a high intensity of brown color, freshness and flavor and also low intensity of bitter and astringent taste. With the lower concentration of 0.5% (w/v), Leaves p+1 and roaster already accepted by consumers.

Intensity the astringent taste and brown color is not only influenced by the tannin content. Intensity the bitter taste is not only influenced by caffeine content. Intensity of flavor is not only influenced by pH. PH ranged from 5.08 – 5.47. Caffeine content ranged from 94.50 – 139.22 ppm, tannins content of Air Kawa ranged from 106.80 – 385.73 ppm.

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