The Effect of Adding Black Rice and White Rice on Rendement, Degree of Lightening, Antioxidant Activity of Coffee Powder and Organoleptic Properties of Coffee Drinks

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Article Info

Article history:

Received Jul 12th, 2017
Revised Aug 20th, 2017
Accepted Oct 26th, 2017

Keyword:

Coffee Powder,
White Rice,
Black Rice

ABSTRACT

Coffee is one of the plantation commodities that have high economic value among other plantation crops and plays an important role as a source of foreign exchange. Each region in Indonesia has a unique way of processing coffee beans into coffee powder, one of them by adding other ingredients such as rice. Therefore it is necessary to further investigate the effect of adding white rice to the yield and quality of coffee powder, as well as the potential of adding black rice as a mixture on the manufacture of coffee powder. The research was conducted in January - February 2017 at Pascapanen Mechanization and Technology laboratory of Assessment Institute for Agriculture Technology (AIAT) of East Java. The experiment design using Completely Randomized Design (RAL), the treatment consists of Pure Coffee (KM), Coffee + White Rice (KBP), and Coffee + Black Rice (KBH). Observation parameters consist of rendement, organoleptic properties, antioxidant activity. The results showed that the addition of black / white rice did not affect the yield, panelist's preference for color, bitter level of steeping coffee. However, the treatment had a significant effect on the degree of brightness (L) and antioxidant activity of coffee powder, panelist's preference for the flavour and taste. The addition of white rice or black rice causes the organoleptic properties likely flavour and taste of KBH and KBP coffee drinks to be less favorable with score 3,18 (netral) for flavor and 3,55 (like) for taste, the color of the coffee powder becomes brighter (L KBH = 35), and increase the KBH antioxidant activity to 44.745%.

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1. INTRODUCTION

Coffee is one of the plantation commodities that have high economic value among other crops plantation and plays an important role as a source of foreign exchange. In addition, coffee is also a source of income for approximately one and a half million coffee farmers in Indonesia (Rahardjo, 2012).

Quality of coffee powder is influenced by many things such as, types / varieties, and postharvest handling of coffee beans. According to Clarke, R.J.dan Macrae, R. (1987) Robusta coffee and arabica have different characteristics. Robusta has a higher total chologenic acid and caffeine content, while Arabica contains relatively higher amino acids and fats.

The current problem is that the increase of powdered coffee production in Indonesia is still hampered by the low quality of coffee beans produced. This is due to improper postharvest handling, such as fermentation, washing, sorting, drying, and roasting. Therefore, to obtain a good quality coffee beans it is necessary postharvest handling and proper processing at each stage in accordance with Standard Operating Procedures. According to Choiron M. (2010) Application of Standard Operating Procedure is very important even can lower the levels of

okratoksin in coffee and increase and uniform the quality of coffee produced coffee farmers. Okratoksin is a toxin / toxic compound that is harmful to the health of the body. This compound is produced by *Aspergilus ochraceus.*

The quality of coffee in addition to being influenced by postharvest handling is also very dependent on the processing until it becomes a coffee powder, one of which is at the stage of roasting. Some people in Indonesia in East Java, in making coffee powder mixed with other ingredients such as corn, rice, coconut. There are also other areas that mix coffee beans with sticky rice, areca nut and corn (Shah, H., Yusmanizar, Oki Maulana 2013). These ingredients besides aimed at increasing the volume of coffee powder also produce coffee powder with a distinctive taste and flavour, such as savory and bitter more concentrated.

Black rice is a local variety that contains the best pigment compared to white rice or other colored rice (Sa'adah, 2013). The pigments or dyes belonging to the flavonoid group are called anthocyanins. Antosianin is an antioxidant that has a positive effect on health. Black rice is a type of black rice with antioxidant content higher than white rice. Black rice has potassium content per 100 grams of 105 mg, protein as much as 7.88% and carbohydrates as much as 74.81%. Colored rice has Antioxidant and it is a molecular structure that provides free electrons to free radical molecules uninterrupted and can break free chain reaction of free radicals.

To know the potential of white rice and black rice in coffee making and to know the quality of coffee produced then it is necessary to do research of coffee making with substitution of white rice and black rice. Therefore, it is expected that the results of this study can add to the repertoire of knowledge in general and knowledge for the community in the processing of coffee beans, especially at the stage roasting.

2. RESEARCH METHOD

The research was conducted in January-February 2017, at the Mechanization and Technology Laboratory of Post-harvest Processing at Assessment Institute for Agriculture Technology (AIAT) of East Java. The material and equipment used were Robusta coffee beans, Ciherang white rice, Black rice, clay fryer, wood stirrer, LPG stove, Disk Mill, 80 mesh sieve.

The experimental design using RAL (Complete Random Design) with 3 treatments they were 1) Pure Coffee (KM), 2) Coffee been + White Rice (KBP) with ratio 70:30, and 3) Coffee been+ Black Rice (KBH) at 70:30 . Coffee powder is made in the following way:

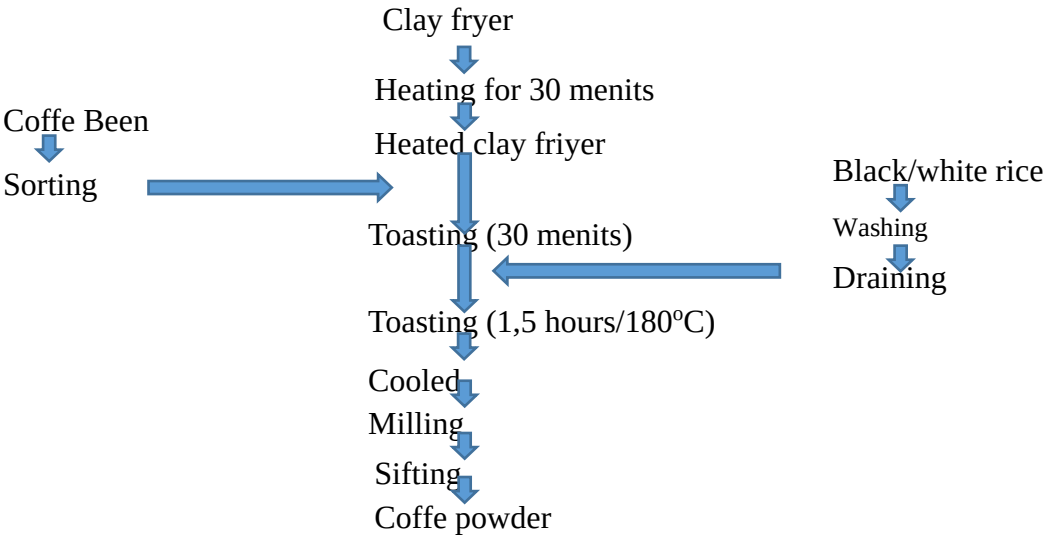

Figure 1. Flow Chart of Coffee Powder Processing

Coffee powder are tested for the physical and chemical properties as 1) rendement, 2) color, 3) organoleptic properties of coffee drinks and 4) antioxidant activity. Analysis of organoleptic properties using Hedonic Test with score 1-5. They were 5 = very like, 4 = like, 3 = netral, 2 = dislike and 1 = very dislike. The number of panelists were 25 semi-trained.

3. RESULTS AND DISCUSSION

1. Rendement

Measurement of rendement using the ratio of dry coffee bean weight and weight of coffee powder. Stages in the process of making coffee powder greatly enables weight shrinkage, as in the stage of roasting that causes evaporation of moisture content and grinding using DiskMil. According to Nugroho (2009) The decrease in the weight of coffee beans during roasting cause the value of reduced yield in accordance with the degree of roaster. The higher the yield indicates that the degree of sangrai is getting lighter, and vice versa. The highest yield of coffee was 81% obtained on the lightest degree of roasting and the lowest degree of sangai (76%) on the dark roast degree. Likewise, at the time of grinding, the mill rotation causes the lightweight coffee powder to easily fly into the environment. According to Shah, H., Yusmanizar, O. Maulana. (2013) grinding coffee beans using higher mill rpm Discs and a much smoother number of fractions than using a Hammer mill.

Table 1. Rendement and weight loss of coffee powder

No.	Treatment	Rendement (%)	Weight loss (%)
1.	KM (Pure Coffee)	82,00a	18a
2.	KBP (Coffee+white rice)	78,67a	21,33a
3.	KBH (Coffee+black rice)	85,00a	15a

The same letter in one column shows no significant difference at the level of 5%

Based on table 1. Statistical analysis of coffee powder showed that the substitution of black rice or white rice did not affect the rendement and weight loss of coffee powder (α>0,05). It happened because both coffee beans and rice get evaporation of water content and weight loss are not significantly different.

According to Varnam and Sutherland (1994) roasted coffee beans are divided into 3 kinds of ligh roast for temperature 193-199^{o}C, medium roast 204^{o}C, dark roast 213-221^{o}C. In ligh roast, 3-5% weight loss, 5-8% for medium roast and 8-14% for dark roast.

In table 1, weight loss reaches up to 21.33%, indicating that beside evaporating, there were some material having lost or scattered. it is happened because coffee powder were have been done as manually.

2. Color visually and degree of brightness (color reader)

The color of the seeds and the coffee powder is influenced by the degree of roasting, the longer the roasting will produce coffee beans and coffee powder which is getting black or called dark roasting degree. But other than that, the color of coffee powder is also influenced by the material, if the coffee beans mixed with other ingredients such as rice, of course, the resulting color of coffee powder will be different.

Visually, coffee beans and coffee powder look different colors between treatments. Pure coffee (KM) has a darker color, or the lowest degree of brightness, whereas Coffee + white (KBP) and Coffee + black rice (KBH) are slightly reddish in color.

Table 3. Degrees of Coffee Powder Brightness (L, a, b)

No.	Treatment	L	a	b
1.	KM (Pure Coffee)	32,10b	+10.10a	+9.02a
2.	KBP (Coffee+white rice)	32,92ab	+11.42a	+11.07a
3.	KBH (Coffee+black rice)	35.00a	+11.07a	+11.32a

The same letter in one column shows no significant difference at the level of 5%

L: indicates brightness, range between 0-100 (0 = black, 100 = white).

a: shows green and red (a + = red, a- = green)

b: shows blue and yellow (b + = yellow, b- = blue)

Figure 2: coffee been and coffee powder

The degree of brightness indicates the brightness value of a product, the greater its value the more bright or pale. The degree of brightness is presented in L (brightness level), a (green-red level), and b (blue-yellow level). Based on the results of statistical analysis, in table 2, showed that the addition of white rice and black rice had an effect on the degree of brightness of coffee powder (α <0,05). KM powder is the lowest degree of brightness or darkest (L = 32.10). The addition of black rice and white rice causes the coffee powder to be brighter on KBP and KBH (L = 32.92-35.00).

The values of KBH and KBP are not significantly different. This shows that coffee powder made by adding 30% white rice is not real with coffee powder made by adding 30% black rice. A + values ranged from 10.10 to 11.42, not significantly different between treatments. Similarly, b + values ranging from 9.02 to 11.32, were not significantly different between treatments.

Coffee beans before roasting have a value of L (Lovibond) 60-65. In lightning roasting (light) color of the coffee bean surface to brown so that the value of L to decrease to 44-45. In medium grader the value of L coffee beans drops back to 38-40 and in dark roasting, coffee beans become darker so close to black the value of L to 34-35. At this stage, the hydrocarbon compound becomes the element of carbon and the sugar compound in the caramelization process, so that the colored beans are getting closer to black and shiny (Mulato 2002)

Table 3. Panelist preference on organoleptic properties of steeped coffee powder

No.	Treatment	Preference for				
		Colour	Flavour	Bitter	Taste	Overall
1.	KM (Pure Coffee)	3,91a	4,09a	3,09a	3,91a	4,00a
2.	KBP (Coffee+white rice)	3,64a	3,00b	2,90a	3,00b	3,27b
3.	KBH (Coffee+black rice)	4,18a	3,18b	3,18a	3,55ab	3,72ab

The same letter in one column shows no significant difference at the level of 5%

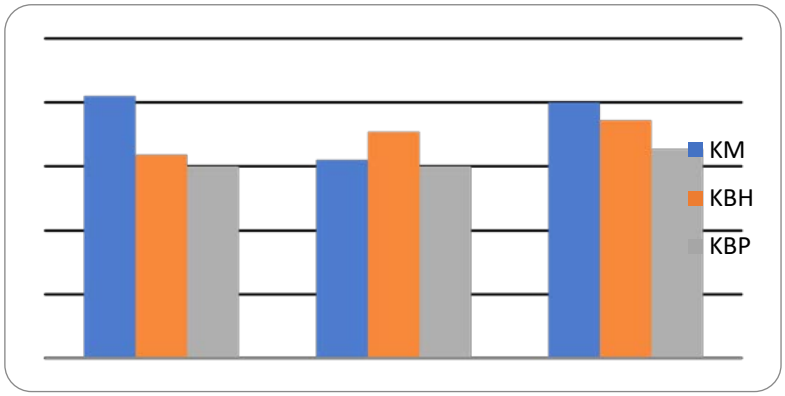

Figure 2. Flavors, taste and overall of pure coffee brew (KM), Coffee + black rice (KBH), Coffee + white rice (KBP) diagrams.

Based on the result of statistical analysis on the level of preference of organoleptic properties of steeping coffee consisting of aroma, taste and appearance as a whole, different between treatments (α <0.05), but not significantly different in color and bitter level of coffee (α> 0, 05). The color of the steeping coffee ranged from 3.64 to 4.18 (neutral-like). The bitter level of steeping coffee ranges from 2.90 to 3.18 (neutral). The smell of coffee ranged from 2.90 to 3.09 was significantly different between treatments (α <0.05), the highest score was 4.09 (preferably) at KM and 3.18 (neutral) on KBH. The coefficient of coffee ranged from 3.00 to 3.91, significantly different between treatments (α <0.05), with the highest score of 3.91 (preferably) obtained from KM treatment and 3.55 (preferably) KBH treatment. In general, KM is still preferable to panelists, but when compared between KBP and KBH, KBH has the preferred organoleptic properties by panelists.

The bitter taste of coffee extracts is a joint mineral breaking of crude fiber, chlorogenic acid, caffeine, tannins and other organic and inorganic compounds (Nopitasari 2010; Varnam and Sutherland 1994). The bitter taste in coffee is influenced by the degree of roasting and the type of coffee and its processing. According to Rouseff (1990) Robusta coffee has a higher content of chlorogenic acid than Arabica coffee. According to Wahyudi and Ismayadi (1995) each coffee is unique because it has a different character and taste. Compounds that play the role of aroma / flavor are sugar, volatile compounds, trigonellin, amino acids and peptides. In addition to the flavor, sugar also plays a role in staining during roasting. While the taste and seduhannya much influenced by carboxylic acids and phenolic acids (Nopitasari 2010). Robusta coffee has a more chocolate-like and bitter taste, a distinctive and sweet aroma, the color of seed varies depending on the way it is treated, while the texture is rougher than Arabica coffee (Anggara and Marini 2011).

Typical aromas are formed at the time of roasting, where the sugar compounds will be salarized, compounds that cause sponge or taste of acids such as tannins and acetic acid will disappear and some will react with amino acids to form melacidin compounds that form a brown color (Mulato 2002)

3. Antioxidant Activity

Table 3. Antioxidant Activity of Coffee Powder

No.	Teatment	Antioxidant Activity (%)
1.	KM (Pure Coffee)	11,335b
2.	KBP (Coffee+white rice)	44,745a
3.	KBH (Coffee+black rice)	44,667a

The same letter in one column shows no significant difference at the level of 5%

In Table 3, the results of statistical analysis of antioxidant activity, KBH and KBP powder were significantly different from KM (α <0.05). KBH and KBP antioxidant activity was higher than KM (44.67-

44,74%). This indicates that the addition of both rice and white rice on coffee making can increase antioxidant activity. Added black rice

Black rice contains anthocyanins that act as antioxidants. The main anthocyanin in black rice is cyanidin-3-glucoside (C3G). C3G is an important source of anthocyanin in Asia. Black rice also contains an active phytochemical that is tocopherol, tocotriol, oryzanols, vitamin B complex and phenolic compounds (Sa'adah, 2013)

CONCLUSION

In coffee powder, white rice substitution and 30% black rice can increase antioxidant activity (44,67-44,74%), brightening the color of coffee powder (L = 32,92-35,00). On organoleptic quality (aroma, flavor and overall) of coffee, 30% substitution of black rice is preferred over 30% white coffee substitute rice, but is no more favorable than pure coffee.

ACKNOWLEDGMENT

This work was carried out as part of “Biofertilizer Unggul dan Komersial dari Marine Yeast dan Bakteri”. This research was supported by grants from Penelitian Pemula 2017 awarded by Dana Lokal ITS tahun 2017.

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