Indonesian Food Science and Technology Journal
IFSTJ : Vol 5 no 1 December 2021
ISSN : 2615-367X

# Influence of Fermentation Conditions on The Antioxidant and Physico-Chemical of Arabica Coffee from Kerinci Region of Indonesia

Addion Nizori[1)], Elkanah Jayanti[1)], Daniel Purba[1#)], Surhaini[1)], Ika Gusriani[2)], and Mursyid [1)]
[1)] Technology of Agricultural Product Department, Faculty of Agriculture, Universitas Jambi, Jambi, 36122, Indonesia.
[2)] Agricultural Technology Department, Faculty of Agriculture, Bengkulu University, Indonesia.
[#)] Corresponding author: danielpurbajambi@gmail.com

***Abstract*—Coffee quality can depend on several factors such as the species/varieties cultivated, the processing after the harvesting phase, geographical origin, and climatic factors. Fermentation is one of the post harvest technology that influence coffee chemical and sensory properties. This study was to determine the effect of fermentation time into antioxidant and physicochemical of Arabica coffee from Kerinci region Indonesia. Research design used was randomized complete design with 5 combinations of treatments, which are 12, 20, 28, 36, and 44 hours fermentation with 3 replicates. The results shows fermentation time have a significant effects on moisture content, pH, antioxidant activity. The duration of fermentation results in increasing higher moisture content, lower pH value and decreased antioxidants. Moreover, the best fermentation time to produce Kerinci Arabica coffee powder with high quality was 36 hours with antioxidant activity (inhibition percentage) 78,08 ± 0,07.**

***Keywords*— *Anaerobic fermentation, coffee processing, antioxidant***

## 1. INTRODUCTION

Coffee is a famous tropical plant that grows at 10–2000 m above sea level. In addition, coffee is very popular commercial commodity. Annual production of 158,930 million 60-kg bags globally and a market value in excess of US$5 billion was recorded for green coffee beans alone in 2017 [1].

The processing of coffee consists of dry and wet processing. The principle of dry processing is that the coffee cherries are dried until their water content is 10-11%, then the horns are peeled off to become rice coffee that has been cleaned of horn skin and epidermis [2].

In wet processing (fermentation) consists of dry fermentation and wet fermentation. The principle of dry fermentation is that the coffee beans after preliminary washing are then milled in the form of small cones which are covered with gunny sacks, dry fermentation is carried out by stacking coffee in a shady place for 2-3 days [3]. Meanwhile, the principle of wet fermentation is that the coffee cherries are sorted then a process of peeling the skin of the fruit is then fermented by immersing in clean water for 12-36 hours. The fermented coffee beans are washed to remove mucus and dried in the sun for 2-3 weeks with regular turning. Coffee beans that have their horn skin peeled will produce rice coffee beans called green beans [4].

According to Balya [5] the time needed to ferment coffee depends on the type of coffee used, generally the fermentation time ranges from 12-36 hours. The fermentation process that is too long will cause an unpleasant taste due to the appearance of acid and unpleasant odors as a result of decay by microorganisms. The temperature used is generally around 30˚C, if the temperature is less than 30 ˚C the growth of acid-producing microorganisms will be slow. Lactic acid bacteria are able to convert glucose into lactic acid. These bacteria are *Lactobbacillus, Streptococcus, Leuconostoc, Pediococcus and Bifidobacterium*.

To the best of our knowledge, many studies are available on the sensory and textural characteristics of non fermented coffee bean, however only few studies were focused on the study the fermented of coffee bean. Therefore, the aims of this research were effect of fermentation time into physicochemical and sensory properties of Arabica coffee from Kerinci region Indonesia.

## 2. MATERIAL AND METHODS

### 2.1 Materials

Coffee bean were obtained from a local farm Koto Tuo districk , Kerinci region, Indonesia. All chemicals used for analytical procedures were analytical grade. Details of chemicals and suppliers were DPPH 0,05 µM. solutions, pH meter and Spectrophotometry UV-Vis,

### 2.2 Preparation of making coffee powder

The coffee cherries that have been ripe (marked with red color) are sorted by placing them in a basin filled with water. Good quality coffee beans will usually sink in the water, while bad quality fruit will appear. The sunken fruit seeds were used in this study. A total of 600g of peeled coffee pods are then carried out naturally wet fermentation by soaking in water in a basin covered with plastic wrap with a little hole. The treatment of long fermentation time is: P1 = 12 hours, P2 = 20 hours, P3 = 28 hours, P4 = 36 hours, and P5 = 44 hours. Water was changed every 3 hours and pH and temperature were measured during fermentation. The next step is washing to remove all the mucus layer and layers that are still left after fermentation. The next stage is drying the coffee beans. Drying was carried out in an oven at 50˚C for 18 hours. The hulls of the coffee beans that have been dried are peeled, then re-dried at 50˚C for 10 hours. Then it is roasted at 190˚C for 20 minutes, after the roasting process is carried out the grinding process using a mortar, then sieved with a 40 mesh sieve and the kerinci arabica coffee powder is made.

Research design used was randomized complete design with which are 12, 20, 28, 36 and 44 hours fermentation with 3 replicates.

### 2.3 Physicochemical analysis

#### 2.3.1 pH

The pH was measured using a pH meter. About 1g of each sample was added to 20 mL of distilled water, homogenized for 30 s, and the pH was then measured. Calibration was performed using standard buffers provided by the manufacturer at pH 4, and 7 at room temperature [6]

#### 2.3.2 Moisture content (MC)

Moisture content (MC) was measured gravimetrically by drying in the oven at 105˚C until a constant weight was achieved according to AOAC Method [6].

#### 2.3.3 Antioxidant activity

Antioxidant activity was measured according to DPPH (2,2-diphenyl-1picryhyrazil) radical-scavenging activity method [7]. Sample was taken around 0.5 g and mixed with 10 ml distillated water, and 3.8 ml DPPH 0,05 µM solution was added, stored at dark room temperature for 30 minutes and finally centrifuged at 3.500 rpm within 10 minutes and sample ready for analyzing with Spectrophotometer UV-Vis. Antioxidant activity was calculated based on 0,05 µM DPPH solution added measured with wavelength at 517 nm. Absorbance of samples recorded was used to calculate the inhibition factor according to formula as bellows:

$$\text{Inhibition (\%)} = \frac{absorbance\ (control) - absorbance(sampel)}{absorbance\ (control)} \times 100\%$$

### 2.4 Statistical Analysis

The statistical analyses were conducted using one-way analysis of variance (ANOVA). Excel software was used to conduct statistical analysis, when significant differences were detected; the differences among the mean values were determined by performing the Duncan's multiple comparison test (DNMRT) at a confidence level of $p < 0.05$ (5%). Data were reported as mean values ± standard deviation

## 3. RESULT AND DISCUSSION

### 3.1 *Antioxidant activity*

The antioxidant activity of Arabica coffee at different fermentation time was evaluated applying the DPPH method and the average percent inhibition value of kerinci arabica coffee powder can be seen in the Table 1.

From the results of the analysis of variance showed that the fermentation time had a very significant effect on the antioxidant Kerinci arabica coffee powder.

Based on Table 1, it can be seen that the 12 hours fermentation treatment was not significantly different from the 20 hours fermentation time but was significantly different from the 28, 36, and 44 hours fermentation time. Based on the research data, it is

known that at 36 hours of fermentation, the highest mean value of% inhibition was 78.08 and at 12 hours of fermentation the lowest average% inhibition value was 74.56. The higher inhibition percentage, the greater the antioxidant activity of coffee in inhibiting free radicals.

Based on Table 1, it can be seen that at 12 to 36 hours of fermentation, the antioxidant activity has increased and at 44 hours of fermentation the antioxidant activity of coffee has decreased slightly. The increase in antioxidants is influenced by phenolic compounds and organic acids. In the fermentation process, phenolic compounds and organic acids in coffee will increase which causes increasing antioxidant activity [8]. The decrease in antioxidant activity is due to the shrinkage of nutrients in the form of natural sugars in coffee beans that are needed by bacteria during the fermentation process to produce phenolic compounds and organic acids so that the long fermentation process causes antioxidant activity to decrease. Another researchers Dewi [8] and Madigan [9] found that most of the lactic acid bacteria get energy from sugar so that their growth is limited to an environment with sufficient sugar.

Antioxidants are electron donors or reductants. This compound has a small molecular weight, but is able to inactivate the development of oxidation reactions by preventing the formation of radicals. Antioxidant activity can be determined by the 1,1- diphenyl-2- picryl hydrazyl (DPPH) method. Testing with the DPPH method is based on antioxidant activity in inhibiting free radicals through Hydrogen Atom Transfer. This mechanism is based on the ability of antioxidants to neutralize free radicals by donating H atoms, so that the purple color of DPPH turns yellow [10]

Table 1. Physicochemical properties of Arabica coffee

| Fermentation time (hours) | Antioxidant Activity (%) | pH | MC* (%) |
|---|---|---|---|
| 12 | 74,56 ± 0,25 [a] | 5,71 ± 0,02 [a] | 3,44 ± 0,02 [a] |
| 20 | 75,61 ± 0,19 [a] | 5,60 ± 0,01 [a] | 3,53 ± 0,03 [b] |
| 28 | 76,87 ± 0,07 [b] | 5,45 ± 0,01 [b] | 3,82 ± 0,02 [c] |
| 36 | 78,08 ± 0,07 [c] | 5,42 ± 0,02 [c] | 3,93 ± 0,03 [d] |
| 44 | 76,50 ± 0,26 [b] | 3.45± 0.12 [d] | 4,03 ± 0,03 [e] |

Noted : Means with different superscript letters in the same column indicate significant differences (p 0.05) between the carriers.
MC* = moisture content.

3.2 pH

The results of analysis of variance showed that the fermentation time had a significant effect on the pH of kerinci arabica coffee powder. The average pH value of kerinci arabica coffee powder based on fermentation time can be seen in Table 1. The average pH value of kerinci arabica coffee from the research results ranged from 5.34 to 5.71. The lowest average pH value of coffee was obtained from 44 hours of fermentation was 5.34 and the highest average value of pH obtained from 12 hours of fermentation was 5.71.

Hadipernata [11] explains that the results of the sugar breakdown process include lactic acid and other acids, namely ethanol, butyric acid, and propionic. The longer the fermentation process, the more acidic the coffee will be. This is caused by the formation of aliphatic acids during the fermentation process.

From Table 1, it can be seen that the data obtained from the research results show that the longer the fermentation, the acidity of the coffee increases, this is in accordance [12] Megah's research which states that in general with the longer fermentation the acidity of coffee will increase. This is caused by the formation of aliphatic acids (citric, malic and quinic acids) during the fermentation process. If the length of fermentation is extended, there will be changes in the chemical composition of the coffee beans, where the

aliphatic acids will change into carboxylic acid esters which can lead to bad fermentation and produce a bad taste. The results of this study are in line with the research of Wilujeng and Wikandari [13] which fermented coffee with lactic acid bacteria, which showed that the longer the fermentation takes place, the more acidic the coffee is. The pH value or degree of acidity is used to express the level of acidity or base that a substance, solution or object has. The normal pH value has a value of 7 while if the pH is more than 7 it indicates the substance has alkaline properties while a pH value less than 7 indicates acidic [14].

### 3.3 Moisture Content (MC)

The results of the analysis of variance showed that the fermentation time had a very significant effect on the moisture content of the kerinci arabica coffee powder produced. Based on Table 1, it can be seen that the highest water content value was obtained at 44 hours of fermentation, namely 4.03% and the lowest water content value at 12 hours of fermentation, namely 3.43%. The longer the fermentation takes place, the higher the water content in the kerinci arabica coffee powder. This is in accordance with the Fardiaz [15] that in fermentation there is a change of glucose into carbon dioxide (CO2) and water (H2O) so that it will increase the moisture content in dry matter.

Meanwhile, Oktadina [16] explained that in addition to changing glucose into carbon dioxide (CO2) and water (H2O), there was also a process of water absorption by the coffee pores during the fermentation process. The longer fermentation process causes more water to be absorbed which results in a high water content in the coffee that is fermented for longer.

The results of this study are in line with research conducted by Fauzi and Tawali [18] which stated that the treatment of fermentation time of 8, 16, and 24 hours had an increase in water content when compared to the 0 hour treatment. In the fermentation of robusta coffee with lactic acid bacteria, it shows that the longer the fermentation, the higher the water content. According to SNI 01-3542-2004 the required moisture content in coffee grounds is a maximum of 7%. Based on the data of this study, it was obtained that the moisture content was between 3.44-4.03% indicating that the water content obtained in the kerinci arabica coffee powder from each fermentation treatment had met the quality standards of the coffee powder.

Moisture content plays an important role in determining the characteristics and duration of food storage. Moisture content is the amount of water contained in a substance expressed in percent. Determining water content is a way to measure the amount of water found in food [19].

## 4 CONCLUSION

Based on research it can be concluded that the duration of fermentation of kerinci arabica coffee has a very significant moisture content, pH value, antioxidants, and color. The duration of fermentation results in increasing higher moisture content, lower pH value and decreased antioxidants. Moreover, the best fermentation time to produce Kerinci Arabica coffee powder with high quality was 36 hours with antioxidant activity (inhibition percentage) 78,08 ± 0,07.

## REFERENCES

[1] ICO. Trade statistics. (2018). http://www.ici.org/trade_statistics.asp Accessed 1 October 2020.
[2] Soenaryo dan Ismayadi. (1988). Pengolahan kopi secara basah. Balai penelitian perkebunan. Jember.
[3] Megah. A.F.Z. Syakbaniah dan Ratnawulan, 2009. Perbandingan karakteristik fisis kopi Luwak (Civet Coffee) dan kopi biasa jenis arabika. Fillar of Physics, Vol2.
[4] Lembaga Tumbuh Alami Kerinci. (2014). Aroma arabika "koerintji kopi". (http://kpshk.org/2014/05/14/aroma-arabika-koerintji-kopi/) Access 17 January 2019.
[5] Balya F. B, S. Suwasono, Djumartin. (2013). Karakteristik fisik dan organoleptik biji kopi arabika hasil pengolahan semi basah dengan variasi jenis wadah dan lama fermentasi (studi kasus di desa pedati dan sukosawah kabupaten bondowoso). Jurusan Teknologi Hasil Pertanian Universitas Jember. Jember.
[6] AOAC. (2005). Official methods of analysis (18th ed.). Washington, DC, USA: Association of Official Analytical Chemist.
[7] Selvi A T, G S Joseph and Jayaprakarsa G K. (2003). Inhibition of growth and aflatoxin production in aspergillus flavus by garcinia indica extract and its antioxidant activity. J. food microbiology 20: 455-460.

[8] Dewi, Hastuti Susanti, Silana agustian. (2013). Aktivitas antioksidan ,kadar fenolik total dan kadar kafein pada fermentasi kombu kopi robusta dalam berbagai konsentrasi gula. Universitas Kristen satya wacana. Salatiga.
[9] Madigan, M T dan Martinko J M. (2006). Brock biology of microorganisms. Eleventh edition. Perarson prentice-Hall. Inc. New Jersey. Hal 143, 934, 967.
[10] Apak, R., K Guclu, B. Demirata, M. Ozyurek, S.E Celik, B. Bectasoglu, K.I. Berker, and D Ozyurt. 2007. Comparative evaluation of various total antioxidant capacity assays applied to phenolic compounds with the cupric assay. Molecules vol 12: 14961547
[11] Hadipernata M, Nugraha S. (2012). Identifikasi fisik, kimia dan mikrobiologi biji kopi luwak sebagai dasar acuan teknologi proses kopi luwak artificial. J Kementer Pertan. 372:117-121
[12] Megah. A.F.Z. Syakbaniah dan Ratnawulan, (2009). Perbandingan karakteristik fisis kopi Luwak (Civet Coffee) dan kopi biasa jenis arabika. Fillar of Physics, Vol2.
[13] Wilujeng, A.A.T dan Wikandari, P.R. (2013). Pengaruh lama fermentasi kopi arabika dengan bakteri asam laktat terhadap mutu produk. j. of chemistry unesa. 2:1-9 Yusriah.
[14] Wills R.B.H, Mc Glasson, B graham, and Joye. (1998). Postharvest, introductionto the physiology and handling of fruit, vegetables and ornamentals, Sydney. University of new south wales.
[15] Fardiaz, S. (1992). Mikrobiologi pangan I. PT. Gramedia Pustaka Utama. Jakarta. 320
[16] Oktadina Fiona Drefin, Bambang Dwi Argo, M. Bagus Hermanto. (2013). Pemanfaatan nanas (ananas comosus l. merr) untuk penurunan kadar kafein dan perbaikan citarasa kopi (coffea sp) dalam pembuatan kopi bubuk. Universitas Brawijaya. Malang.
[17] Fauzi Muhammad, Giyarto, Wijayani reza. (2015). Karakteristik kimia biji kopi robusta hasil fermentasi menggunakan mikroflora asal feses luwak. univeristas jember. jember.
[18] Tawali abu B, Abdullah nurlailah, Wiranata benni. (2013). Pengaruh fermentasi menggunakam bakteri asam laktat yoghurt terhadap citarasa kopi robusta (coffea robusta). Universitas Hasanuddin. Makasar
[19] Ananda A D. (2009). Aktivitas antioksidan dan karakteristik organoleptik minuman fungsional the hijau rempah instan. Fakultas pertanian. Institut Pertanian Bogor. Bogor.