

Profile of FTIR (Fourier Transform Infra Red) and Comparison of Antioxidant Activity of Coffee with *Tiwai* (*Eleutherine americana* Merr)

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ABSTRACT

Coffee consumption is increasing and it has become part of people's lifestyle, so there is a need for an innovation in coffee making with the addition of local ingredients such as *tiwai* onions. This study analyzed the chemical profile using FTIR and the antioxidants of coffee, *tiwai* and their mixtures. FTIR results show that roasted coffee is compared to green coffee (without roasting) the components remain the same, there is only a slight change in the absorbance reduction, FTIR results in the wave number range of 2800 to 3000 in roasted ground coffee there are two curves but after being mixed with *tiwai* powder only one absorption curve is 2936.09 at 0.14 absorbance. Green coffee powder, roasted coffee powder, *tiwai* powder, mixture of *tiwai* powder and roasted coffee powder, and coffee powder mixture with instant *tiwai* each have antioxidant components, especially in the absorption of O-H bonds which form phenol compounds (flavonoids). The highest antioxidants were green coffee powder, roasted coffee powder, *tiwai* powder, mixed roasted coffee powder with *tiwai* powder, and roasted coffee powder with instant *tiwai*, respectively.

Keywords: Antioxidants, Coffee, FTIR, *Tiwai*.

1. INTRODUCTION

Consumer needs for functional food are increasing, so it is necessary to make inventions and innovations based on existing local resources. The chosen food development is a plant with the local name onion, onion, Dayak or *Tiwai* which is believed by the Dayak people of Kalimantan to cure various types of diseases. *Tiwai* onions (*Eleutherine americana* Merr.) can be used to treat several types of diseases such as hypertension, diabetes, rheumatism, gout, inflammation, lowering cholesterol in the blood [1]. To get these benefits, *tiwai* onions can be consumed in the form of drinks called herbal drinks [2]. Onion *tiwai* herbal drink can also lower cholesterol (LDL) in hypercholesterolemic patients [3]. *Tiwai* onion extract can be used as food coloring, the color of *tiwai* onion extract is influenced by pH, sugar, temperature, salt, *tiwai* onion extract can be made as candy [2-4]. In the process of making flake cereal, added *tiwai* onion extract can reduce the glycemic index of cereal foods [5]. For the formulation of *tiwai* onion bulbs, soursop leaves and coffee leaves had a significant effect

on the hedonic aroma test, and had no significant effect on water content, ash content, speed of color formation, taste hedonic, and on the hedonic color test of herbal drinks produced. The results showed that the drying method with roasting had better antioxidants than oven and sun drying. The roasting drying method has a weakness because it produces more sliced fractures in *tiwai* onions, thus giving rise to the idea to make *tiwai* coffee, which is a mixture of coffee with *tiwai* onions [6]. Drinking coffee is a way of life for people. With the high demand and coffee being a lifestyle of the people, it is necessary to continue to innovate in coffee making by adding local ingredients, such as *tiwai* onions and its diversification of products. This study aims to determine the chemical profile of *Tiwai* coffee drink with FTIR and antioxidant activity.

2. MATERIALS AND METHOD

2.1. Materials and Tools

The materials used in this study were *tiwai* onions from farmer aged 10 months on Jl Ring Road 2

Bengkuring, Samarinda, Arabica coffee beans obtained from farmer in Teluk Pandan, East Kutai Regency, ethanol 95 % (Merck), 2,2-diphenyl-1-picrylhydrazyl (Himedia RM 2798-1G), Vitamin C (Merck). The tools used are blender, sieve and Thermo Nicolet IS 10 FTIR.

2.2. Preparation of Roasted Tiwai Powder and Instant Tiwai Extract

Tiwai onions are washed using running water which aims to remove impurities, then drained. After that, it was cut with a size of ± 1 mm. *Tiwai* onions that have been cut are then air-dried for 2 days. Then it is roasted until it turns blackish brown. Then cooled at room temperature, then refined using a blender, and sieved 80 Mesh.

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2.3. Preparation of Green and Roasted Coffee Powders

Green coffee powder is obtained by grinding coffee beans with a blender and then sifting with 80 mesh. For roasted coffee powder, dried coffee beans are roasted until blackish brown, then cooled at room temperature, refined using a blender and sieve 80 Mesh

2.4. Preparation of Coffee Powder and Instant Tiwai Mixture

The coffee powder is mixed with instant *tiwai* in a ratio of 1:2 (10 grams of coffee and 20 grams of instant *tiwai*), then mixed using a blender (Kitchen Cook Mixer LJ70001) with a rotation speed of 1 with a time of 30 seconds.

2.5. Preparation of Coffee Powder and Tiwai Powder Mixture

The coffee powder is mixed with ground *tiwai* in a ratio of 3:1 (15 grams of powdered coffee and 5 grams of powdered *tiwai*).

Then green coffee, roasted powder coffee, *tiwai* powder, a mixture of roasted powder coffee with powder *tiwai*, roasted powder coffee with instant *tiwai* were analyzed by FTIR (Thermo Nicolet IS 10 FTIR test (Beam splitter: KBr / Ge mid-infrared, Detector Type: Deuterated TriGlycine Sulfate (DTGS) and antioxidants.

2.6. Chemical Profile Analysis with FTIR

Thermo Nicolet IS 10 FTIR test (Beam splitter: KBr / Ge mid-infrared, Detector Type: Deuterated TriGlycine

Sulfate (DTGS), Accessories: Smart ATR Diamond. The FTIR spectra were recorded on a Nicolet iS10 FT-IR spectrometer equipped with crystal cell diamonds to assess the attenuated total reflection (ATR) operation [7].

2.7. Analysis of Antioxidants

Antioxidant activity test was carried out using spectrophotometry with the DPPH method (2,2-diphenyl-1-picrylhydrazyl) Himmedia RM 2798-1G. Before analyzing the antioxidant activity of each green coffee powder, roasted coffee powder, *tiwai* powder and the treatment mixture, a maceration process was carried out using 95% ethanol (Merck). The sample obtained was then weighed as much as 3 g and then added 30 mL of 95% ethanol, then stirred with a stirring rod for 5 minutes. Furthermore, soaked for one night (24 hours) with a closed state. The results of the immersion are then filtered using Whatman Filter Paper Grade 91 Circles pore size 10 μ m and the filtrate is obtained. Then all the filtrate obtained from the maceration was evaporated using a water bath to obtain a thick extract from the sample. As for the antioxidant test, 1 mL of extract that has been diluted in ethanol was added to 1 mL of DPPH and at the same time, a control consisting of 1 mL of DPPH with 1 mL of 95% ethanol. The reaction mixture was mixed well and then incubated in the dark at room temperature for 30 minutes. The absorbance was measured at a wavelength of 517 nm using a UV Spectrophotometer. Vitamin C was used as a positive control, and 95% ethanol was used as a blank. The ability of DPPH extract is calculated using Equation 1.

$$\% \text{ Antioxidant activity} = \frac{\text{Abs. control} - \text{Abs. sample}}{\text{Abs. control}} \times 100 \quad (1)$$

Note:

Abs. control: absorbance of DPPH + ethanol

Abs. control: absorbance of DPPH radical + sample

The parameter to interpret the results of the DPPH test is to calculate the IC₅₀ value. IC₅₀ is the concentration of substrate or sample solution that can reduce antioxidant activity by 50%. The smaller the IC₅₀ value, the higher or better the antioxidant activity. The IC₅₀ value was obtained from the linear equation ($y = ax + b$) of the percentage of DPPH radical inhibition against several concentrations of sample extracts [8].

3. RESULTS AND DISCUSSION

3.1. FTIR (Fourier Transform Infra Red)

3.1.1. Green Coffee Powder

The FTIR results show the highest indentation peaks at wave number 1030.77, then 2925.49, 1643.05,

3343.00, 2851.24 and 1381.75 and there are several indentations at absorption 600 to 900 (Figure 1).

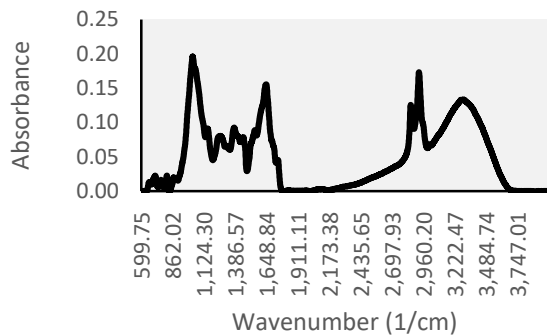


Figure 1. Green coffee FTIR results

According to Skoog and Nieman (1998), the absorption of 690-900 is a representation of the absorption of CH bonds (aromatic and alkene groups), in the curves of 1030.77 and 1381.75 is a CO bond (ester, ether, alcohol and carboxylic acid groups), curves 1381.75, 2851.24 and 2925.49 is a strong CH bond (alkane group) and 3343.00 is an OH bond (phenol and alcohol monomer). The absorption of O-H bonds is the formation of phenolic compounds (flavonoids) which are antioxidants [7,9,10].

3.1.2. Roasted Coffee Powder

The FTIR results in Figure 2 show that roasted coffee compared to green coffee (without roasting) the components remain the same, there is only a slight change in the decrease in absorbance, but the FTIR graphic pattern is the same and in the same wavenumber range. For example, the highest absorbance of roasted coffee is at 1024.98 bending bond absorption at 0.15 absorbance, while the green coffee FTIR 1030.77 at 0.20 absorbance represents the absorption of C-O bonds (ester, ether, alcohol, and carboxylic acid groups) [7].

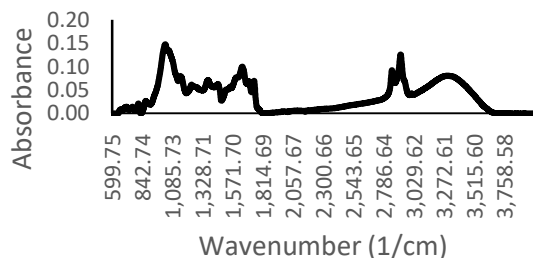


Figure 2. Results of FTIR roasted coffee

3.1.3. Roasted Tiwai Powder

The FTIR The FTIR results show the highest indentation peak at wavenumber 1008.59 with an

absorbance of 0.36, then 3343.96 with an absorbance of 0.14, 1644.98 with an absorbance of 0.11, 2932.23 with an absorbance of 0.10 (Figure 3). In the curve 1008.59 is a CO bond (ester, ether, alcohol and carboxylic acid groups), indentation 1644.98 is a C=C bond (alkane group), indentation 2932.23 is a CH bond (alkane) and 3343.96 is an OH bond representing phenol and alcohol monomer [7,10]. *Tiwai* has phenolic and antioxidant components [1,6].

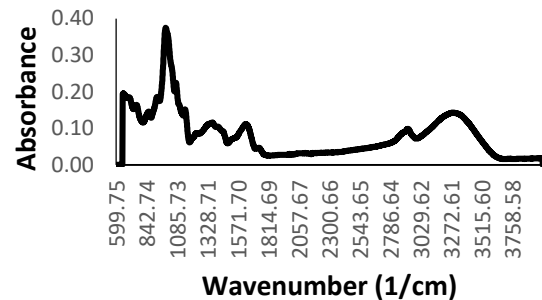


Figure 3. FTIR results of roasted *tiwai* powder

3.1.4. Roasted Coffee and Tiwai Powder Mixture

After mixing the roasted coffee powder with *tiwai* powder in a ratio of 3:1 (15 grams of coffee powder and 5 grams of *tiwai* powder), the FTIR results in the range of wavenumbers from 2800 to 3000 in roasted coffee have two indentations but after being combined with *tiwai* powder the absorption curve becomes one, namely 2936.09 at an absorbance of 0.14, predicted indentation is a CH bond (alkane) [7]. The mixture of roasted coffee powder with ground *tiwai* from the FTIR results (Figure 4) shows that the absorption and bonding curves are very similar but there is a decrease in absorbance in coffee powder and *tiwai* compared to coffee powder and instant *tiwai*. The highest absorbance peak for coffee powder and *tiwai* powder was at an absorbance of 0.53, with an indentation of a wave number of 989.30, while for coffee powder and instant *tiwai* with an indentation at a wavenumber of 988.34 with an absorbance of 0.57.

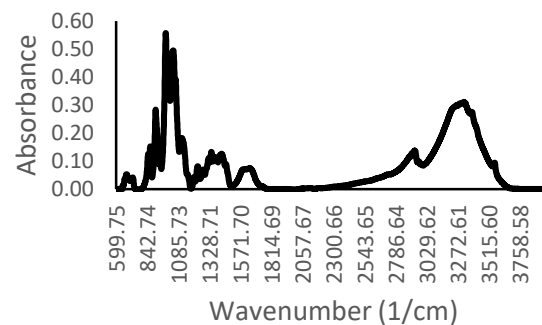


Figure 4. FTIR results of roasted coffee and *tiwai* powder

3.1.5. Roasted Coffee Powder and Instant Tiwai Mixture

The After mixing roasted coffee powder with instant *tiwai* extract in accordance with the comparison of the method with 10 grams of coffee powder and 20 grams of instant *tiwai*, the FTIR results in the range of wavenumbers from 2800 to 3000 in roasted coffee powder have two indentations but after being combined, the absorption curve is also obtained. one is 2936.09 at an absorbance of 0.14. In the range of wavenumbers from 3001 to 4000, the absorbance increased and was highest at 3317.93 with an absorbance of 0.33 (Figure 4), while in ground coffee 3346.86 with an absorbance of 0.08 (Figure 3). The results of this study indicate that the indentations in green coffee, roasted coffee, *tiwai* powder, a mixture of *tiwai* powder with roasted coffee powder, and a mixture of coffee powder with *tiwai* extract each have antioxidant components, especially in the absorption of O-H bonds at a wavelength of 3200-3650 found in the five types of products (Figures 1-5) that form phenol compounds (flavonoids) [7].

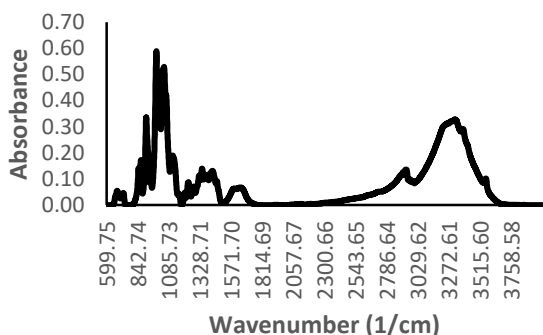


Figure 5. Roasted coffee and instant *tiwai*

3.2. Antioxidant Activity

The results showed that the antioxidant activity from highest to lowest in a row were as follows: green coffee, roasted coffee powder, *tiwai* powder, a mixture of roasted coffee powder with *tiwai* powder, roasted coffee powder with instant *tiwai* (Table 1). Based on the antioxidant activity of green coffee and roasted coffee powder, they are classified as strong antioxidants, while *tiwai* powder, a mixture of roasted coffee powder with *tiwai* powder, a mixture of roasted coffee powder with instant *tiwai*, is in the medium category. Then instant *tiwai* is a weak antioxidant category. Classification of antioxidants < 50 ppm is very strong, 50-100 ppm is strong, 101-150 ppm is moderate and 151-200 ppm is weak [11]. This is predicted due to the change the curve of coffee at a wavelength of 2925.49, to shorten after being mixed with *tiwai* and is supported by the FTIR results in the previous 2800-3200 wave that there are two indentations that become one after mixing coffee and *tiwai*.

Table 1. Antioxidant activity of coffee and *tiwai*

Samples	Antioxidant activity (IC ₅₀) ppm
Green coffee	67±2.34
Roasted coffee powder	72.03±3.22
Roasted <i>tiwai</i> powder	102.24±1.54
Instant <i>tiwai</i>	183.01±1.16
Roasted coffee powder and instant <i>tiwai</i>	146.01±1.21
Roasted coffee powder and roasted <i>tiwai</i> powder	117.04±1.34
Vitamin C (control)	43.33±2.13

The antioxidant activity of green coffee cherries from the Merapi category is very strong [12]. The results of other studies also show that coffee has a strong antioxidant activity with an IC₅₀ value of 50 ppm [13]. Antioxidant activity of roasted coffee bean extract of Arabica (*Coffea arabica*) from Wamena in the medium category with an IC₅₀ value of 107.7 ppm [14]. The filtrate and water macerate deposits of robusta green coffee beans are 262.41 ppm and 244.42 ppm [15]. Differences in antioxidant activity can be caused by processing, coffee varieties and coffee growing places [12,16].

The antioxidant activity of the ethanol extract of the Dayak onion bulb was very strong with an IC₅₀ value of 41.46 mg/L [17], compared to the moderate category in this study in the form of roasted *tiwai* powder. The results of previous studies showed that *tiwai* onions have a phenol component as a source of antioxidants [6] and it is also proven in the FTIR results in Figure 3 that the absorption of O-H bonds is a form of phenolic compounds (flavonoids) which are antioxidants.

4. CONCLUSION

The FTIR results in the range of wavenumbers from 2800 to 3000 in roasted coffee have two indentations but after being mixed with *tiwai* powder the absorption curve is only one, namely 2936.09 at an absorbance of 0.14. Green coffee, roasted coffee, *tiwai* powder, a mixture of *tiwai* powder with roasted coffee powder, and a mixture of coffee powder with instant *tiwai* each have antioxidant components, especially on the absorption of O-H bonds which form phenolic compounds (flavonoids). The highest antioxidants (IC₅₀) were 67 ppm green coffee, 72 ppm roasted coffee, 102 ppm powdered *tiwai*, a mixture of roasted coffee with roasted *tiwai* powder of 117 ppm and roasted coffee with instant *tiwai* of 146 ppm.

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