

Liberica Coffee (*Coffea liberica* L.) from Three Different Regions: *In Vitro* Antioxidant Activities

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Abstract: Free radicals are unstable molecules with unpaired electrons in their outer orbitals. An antioxidant is a compound that can be scavenged free radicals. Coffee is one of the natural antioxidants. This research aimed to study the antioxidant activity of medium roasted beans of liberica coffee (*Coffea liberica*) from three different regions by DPPH and CUPRAC methods. To determine total phenolic content (TPC) and total flavonoid content (TFC), analyze the correlation between TPC and TFC with AAI DPPH and CUPRAC and the correlation between two methods in sample extracts. The sample was extracted by reflux using n-hexane, ethyl acetate, and ethanol. AAI DPPH in the range of 0.397- 18.536, while CUPRAC 0.532-4.674. The highest TPC in ethanol extract of liberica coffee from Aceh (22.585 ± 1.610 g GAE/100 g) and the highest TFC in ethyl acetate extract of liberica coffee from Aceh (4.927 ± 0.355 g QE/100 g). TPC of all samples had a positive and significant correlation with AAI DPPH and CUPRAC. AAI DPPH and CUPRAC value gave a significant and positive correlation. TPC of liberica coffee from three different regions contributed to antioxidant activity by DPPH dan CUPRAC methods. The two methods showed linear results in antioxidant activities of liberica coffee from three regions.

Keywords: antioxidant; liberica coffee; Riau; Aceh; Jambi; DPPH; CUPRAC.

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1. Introduction

Free radicals are unstable molecules with unpaired electrons in their outer orbitals [1]. Our body can produce free radicals from metabolism processes, and they can also be obtained from UV-light, cigarettes, and other chemicals [2].

Antioxidants are stable molecules that can donate an electron and prevent oxidation reactions by binding to the free radicals [1]. One of the natural antioxidants that can be consumed to increase our body's antioxidant capacity can be retrieved from secondary metabolites in plants such as phenol and flavonoid compounds.

Human health can be affected by the balance of free radicals and antioxidants in the body. The accumulation of free radicals in the body can cause a decreased tissue or organ function as time goes by and cause degenerative diseases such as cancer, diabetes mellitus, hypertension, and coronary heart disease [1]. These problems are caused by the excess of free radicals that will attack the body's lipid, protein, and DNA components, which causes oxidative stress.

Coffee is one of the most famous plantation products, and this plant also can be founded in many countries. Since ancient times, coffee beans are usually processed into various kinds of food and beverages because of their unique taste. Its taste comes from some metabolites that

the green beans had during the harvesting process or the metabolites created after a roasting process [3-5]. Drinking coffee is very usual as a lifestyle and habit for certain people [6]. Besides that, coffee beans can also be used as cosmetic ingredients, and their pharmacological effects are used to prevent degenerative diseases due to their abundant antioxidant content [7-8]. People in Indonesia consume Arabica(*Coffea arabica*), Robusta(*Coffea canephora*), and Liberica (*Coffea liberica*).

The origin of liberica coffee is Liberia, Africa. In the 19th century, this coffee was brought to Indonesia to replace arabica coffee that pests attacked. The taste of these coffee beans is more similar to robusta coffee than arabica coffee. While arabica coffee has caramel and sweet notes, the robusta one has spicy, pungent, and earthy notes [9-10]. Meanwhile, liberica coffee beans have an aroma like jackfruits, and the size of the beans is larger than the two other types of coffee.

The coffee beans, which are generally consumed, will pass the roasting process. This process is divided into three types, light roast, medium roast, and dark roast. The roasting process will affect the taste, color, and smell of the coffee beans [11]. Medium roasted coffee is the most favorite coffee because it has a slightly sweeter taste, medium acidity and can maintain the roasted coffee beans [12].

This research aimed to study the antioxidant activity of medium roasted beans of Liberica coffee (*Coffea liberica*) from three different regions by DPPH and CUPRAC methods. To determine total phenolic content (TPC) and total flavonoid content (TFC), analyze the correlation between TPC and TFC with AAI DPPH and CUPRAC and the correlation between two methods in sample extracts.

2. Materials and Methods

2.1. Materials.

Medium roasted liberica coffee beans from three regions (Riau, Aceh, and Jambi), methanol, ethyl acetate, n-hexane, DPPH (2,2-diphenyl-1-picrylhydrazyl), ascorbic acid, cupric chloride, aquadest, neocuproine, ethanol, ammonium acetate, gallic acid, Folin-Ciocalteu reagent, sodium carbonate, quercetin, aluminum (III) chloride, and sodium acetate.

2.2. Preparation of sample.

Medium roasted liberica coffee beans were collected from three regions: Riau province-Meranti Island, namely R, Aceh province-Gayo districts as A, and Jambi province-Tanjung district as J. Those samples were ground into powder.

2.3. Extraction.

Three hundred grams of each powdered samples were extracted using the reflux method with three different solvents' polarities (n-hexane, ethyl acetate, and ethanol). The extraction process was repeated three times for each solvent to get the maximum amount of extracts. Before changing the solvent, powdered samples were dried first. There were nine extracts: three n-hexane extracts (namely R1, A1, and J1), three ethyl acetate extracts (R2, A2, and J2), and three ethanol extracts (R3, A3, and J3).

2.4. Antioxidant activity index determination using DPPH method.

Antioxidant activity determination using the DPPH method started by preparing 39.4 µg/mL DPPH in methanol. Furthermore, the absorbance of DPPH was measured by UV-visible spectrophotometer Beckman Coulter DU 720 at 517 nm to get the A_0 value. That solution can be stored in the refrigerator at 4°C for 24-48 hours to reduce absorbance ± 0.2 . Ascorbic acid as standard was prepared in a stock solution (diluted using methanol to obtain a concentration of 0.05-3 µg/mL). Each ascorbic acid solution with different concentrations was pipetted into a DPPH solution (1: 1). After 30 min of incubation, the absorbance was read at λ 517 nm using a UV-visible spectrophotometer to get a calibration curve and calculate the IC_{50} of ascorbic acid using the reduction of DPPH absorbance [13]. Methanol was used as a blank and 39.4 µg/mL DPPH as a control. The analysis was done in triplicate for the standard and each extract. IC_{50} of each extract was determined using its calibration curve of DPPH absorbance. The antioxidant activity index was concluded by dividing the standard or extract concentration with IC_{50} value.

2.5. Antioxidant activity index determination using the CUPRAC method.

The antioxidant activity index was adopted from Apak *et al.* 2013 [14]. This method began by making 100 µg/mL of CUPRAC solution in ammonium acetate buffer pH 7. This solution's absorbance was measured by UV-visible spectrophotometer Beckman Coulter DU 720 at 517 nm to get the A_0 . Ascorbic acid as standard was prepared in a stock solution (diluted using methanol to obtain a concentration of 1.5-5 µg/mL). Each ascorbic acid solution with different concentrations was pipetted into CUPRAC solution (1: 1). After 30 min of incubation, the absorbance was read using a UV-visible spectrophotometer Beckman Coulter DU 720 at λ 450 nm to obtain a calibration curve and determine the EC_{50} ascorbic acid using the increase of CUPRAC absorbance. Ammonium acetate buffer pH seven was used as a blank and 100 µg/mL CUPRAC as a control. The analysis was done in triplicate for the standard and each extract. EC_{50} of each extract was determined using its calibration curve of CUPRAC absorbance. The antioxidant activity index was concluded by dividing the standard or extract concentration with the EC_{50} value.

2.6. Total phenolic content (TPC) determination.

The total phenolic content determination was adopted from Pourmorad *et al.* 2006 [15] using the modified Folin-Ciocalteu method. Gallic acid as standard was prepared in different concentrations (40-130 µg/mL). Each gallic acid solution with different concentrations was taken 0.5 mL and then added with 5 mL of 10% Folin-Ciocalteu reagent. To the mixture 4 mL of sodium carbonate 1 M. After 15 min of incubation, the absorbance was measured by UV-visible spectrophotometer Beckman Coulter DU 720 at 765 nm. Methanol with Folin-Ciocalteu and sodium carbonate was used as a blank. Each absorbance of gallic acid was applied to obtain the gallic acid calibration curve. The analysis was done in triplicate for the standard and each extract. Each extract's total phenolic content was determined using the gallic acid calibration curve and reported as a percentage of total gallic acid equivalent per 100 g extract (g GAE /100 g).

2.7. Total flavonoid content (TFC) determination.

The determination of total flavonoid content was adopted from Chang *et al.*, 2002 [16]. Quercetin as standard was prepared in different concentrations (60-130 µg/mL). Each quercetin solution with different concentrations was taken as much as 0.5 mL and then added with 1.5 mL of methanol, 2.8 mL of aqua dest, 0.1 mL of 10% AlCl₃, and 0.1 mL of sodium acetate 1 M. After 30 min of incubation, the absorbance was measured by UV-visible spectrophotometer Beckman Coulter DU 720 at λ 415 nm. Each absorbance of quercetin was used to find the quercetin calibration curve. The analysis was done in triplicate for the standard and each extract. Each extract's total flavonoid content was investigated using the quercetin calibration curve and reported as a percentage of total quercetin equivalent per 100 g extract (g QE /100 g).

2.8. Statistical method.

Each sample analysis was performed in triplicate. All of the results presented in means (standard deviation). Statistical analysis using one-way ANOVA with a statistical significance level set at $p < 0.05$ and carried out with SPSS 20 for Window. Pearson's method was used to assign the correlation between the total phenolic, flavonoid content, antioxidant activities, and the correlation between two antioxidant activity methods.

3. Results and Discussion

The previous research [17-21] said that *Coffea* sp. had antioxidant activity. The quality and quantity of various compounds in the coffee beans depend on the coffee types, roasting process due to heterocyclic compounds formed through Maillard reactions in roasted coffee, extraction procedure, and the methodology antioxidant activity determination [6, 18, 22-26]. There are three types of roasting processes. Lightly roasted coffee is a type of coffee that is burned at 230°C for 12 min. Medium roasted coffee is a type of coffee that many people favor. This type of coffee has passed the roasting process at 240°C for 14 min. Simultaneously, dark roasted coffee is a type of coffee roasted at a temperature of 245°C for 15 min [11]. These roasting processes changes the chemical composition in the coffee beans, leading to the changing of flavor, aroma, and browning pigments. Roasted coffee beans contain melanoidins, which are produced from non-enzymatic browning exhibit antioxidant activity [27].

Liberica coffee beans are among the most consumed coffee globally, even though their popularity is below arabica coffee and robusta coffee [21]. There was just limited research discussing the antioxidant activity of liberica coffee. There was no study concerning the antioxidant activity of three various polarity extracts (which were n-hexane, ethyl acetate, and ethanol) from three different regions using DPPH and CUPRAC methods.

Based on the mechanism, there are two kinds of methods that can be used to determine antioxidant activity, hydrogen transfer method and electron transfer method. DPPH is an example of a hydrogen transfer method, while CUPRAC is one of the electron transfer methods. DPPH free radicals can be used to determine antioxidant activity. The color of DPPH will be changed from purple to yellow because of the reduction of DPPH by hydrogen donation. The intensity of color change is comparable with reducing DPPH absorption at wavelength 517 nm [13]. The antioxidant activity determination principle using the CUPRAC method is the reduction process of Cu²⁺ to Cu⁺ that will form a complex with neocuproine. CUPRAC free radicals dissolve in methanol have characteristic absorption at wavelength 450 nm [14].

The results of a previous study [21] about the determination of antioxidant activity from three different types of coffee beans using the DPPH method shown that the green beans of liberica coffee have the highest antioxidant activity, followed by arabica coffee and robusta coffee. The existence of the volatile extracts in the green coffee beans may play a role in providing antioxidant activity. The main phenolic compound most linked to sugars as glycosides usually found in green coffee beans is chlorogenic and caffeic acid [27-28]. The chemical constituents include the terpene alcohols such as linalool, α -terpineol, nerol, geraniol, guaiacol, and eugenol (Z) isoeugenol, p-vinyl guaiacol, and p-vinyl phenol. Other heterocyclic components are caffeine, several furans, and pyrroles [22-31]. Liberica coffee has the highest antioxidant activity due to the higher content of non-phenolic antioxidants than other coffee types. A study by Patay EB *et al.* 2016 [19] revealed that ethanolic extract of liberica coffee beans have a higher antioxidant capacity (2212.817 ± 204.156 TE mmol/g dried plant) compared to robusta and arabica coffee (1691.492 ± 153.326 TE mmol/g dried plant and 1627.089 ± 158.675 TE mmol/g dried plant). Meanwhile, the previous study [7] showed that robusta SCG (one of the significant residues of raw coffee when the coffee powder is treated by hot water) has the highest value of DPPH inhibition $41.63 \pm 0.04\%$ among arabica and liberica SCG. From the studies above, it can be concluded that although liberica coffee beans are less popular and the SCG of liberica coffee gave the lower result, the antioxidant activity of liberica coffee extracts can be opposed to arabica coffee and robusta coffee [32-33].

The Antioxidant Activity Index (AAI) of various extracts from three different liberica coffee regions using DPPH and CUPRAC methods were shown in Figures 1 and 2. Those values were compared to AAI ascorbic acid as standard. The highest value of AAI means the extract has the most increased antioxidant activity. A sample was stated to have a very strong antioxidant activity if the AAI value obtained above 2, strong antioxidant activity if the AAI value 1-2, moderate antioxidant if the AAI value 0.5-1, and weak antioxidant if the AAI value under 0.5 [34].

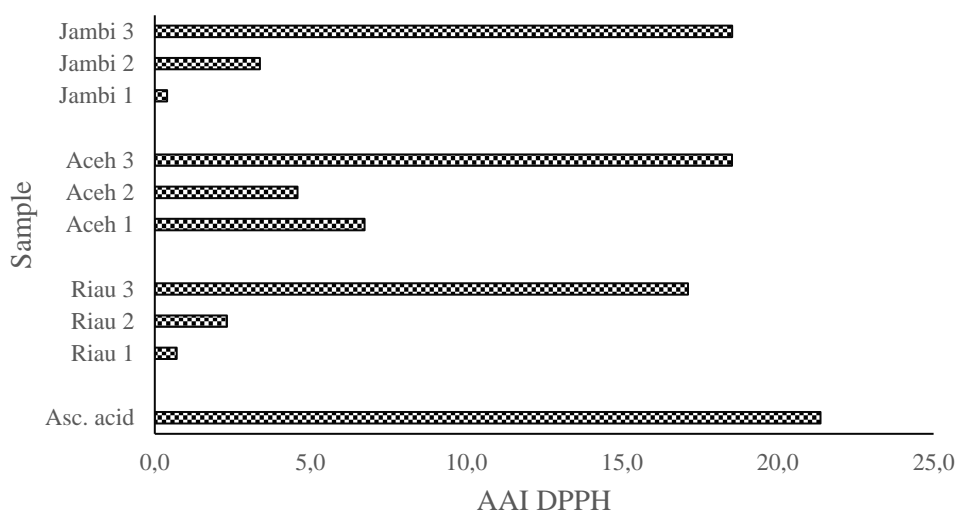


Figure 1. Antioxidant activity index data of liberica coffee beans by DPPH method.

The present study results showed that the highest AAI of DPPH and CUPRAC methods from n-hexane extracts were given by liberica coffee from Aceh (A1) (6.74 ± 0.26 and 0.58 ± 0.004). The highest AAI of DPPH and CUPRAC methods from ethyl acetate extracts were also given by liberica coffee from Aceh (A2) (4.58 ± 0.24 and 2.33 ± 0.015). In contrast, liberica coffee from Jambi was the highest AAI of DPPH and CUPRAC methods from ethanolic

extracts (J3) (18.54 ± 1.49 and 4.67 ± 0.03). From all the data in Figure 1, it can be stated that AAI from the DPPH method of various extracts of liberica coffee medium roasted from three different regions ranged from 0.40 to 18.54. The lowest index showed by n-hexane extract from Jambi (J1) (0.40 ± 0.03), and the highest index showed by an ethanolic extract from Jambi (J3) (18.54 ± 1.49). Meanwhile, AAI from the CUPRAC method of various extracts of liberica coffee medium roasted from three different regions in Figure 2 ranged from 0.53 to 4.67. The lowest index showed by n-hexane extract from Jambi (J1) (0.53 ± 0.002), while the ethanolic extract from Jambi showed the highest value (J3) (4.67 ± 0.03). The AAI of ascorbic acid from DPH and CUPRAC methods were 21.37 ± 0.03 and 21.99 ± 1.87 .

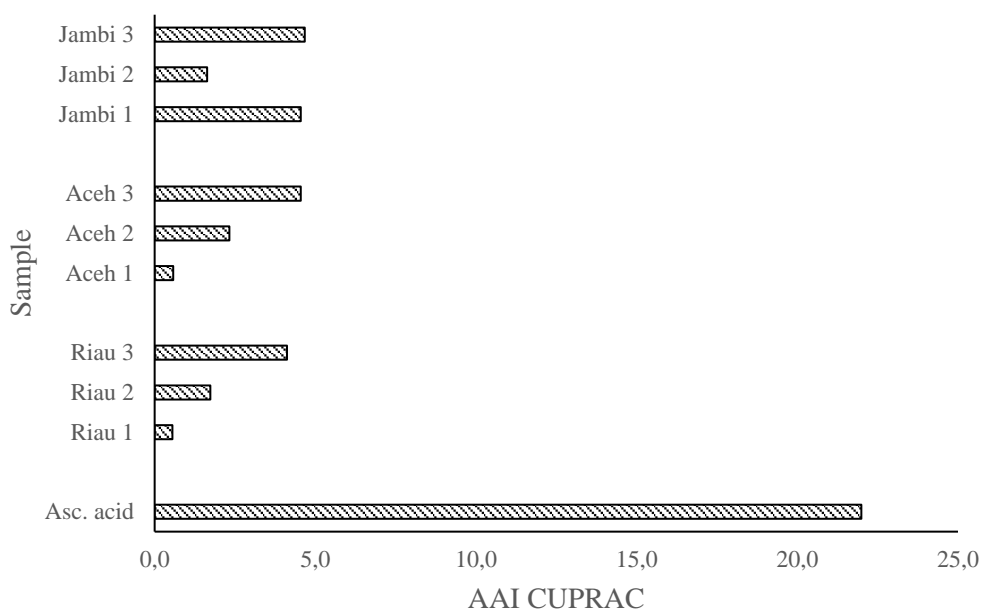


Figure 2. Antioxidant activity index data of liberica coffee by CUPRAC method.

A previous study [35] used the same solvents as the present study (n-hexane, ethyl acetate, and ethanol). However, the samples are arabica green coffee beans from three regions. IC_{50} of the DPPH method ranged from 0.70 to 134.56 mg/mL. The highest value showed by ethanolic extract, and the n-hexane extract showed the lowest value. The result is the same as this study. Research by Acidri R *et al.* 2020 [17] showed the IC_{50} DPPH of roasted arabica coffee beans (29.3 ± 1.40 μ g sample/mL) was lower than the antioxidant activity of arabica green beans (35.4 ± 1.49 μ g sample/mL). The roasted arabica coffee beans have a higher antioxidant capacity than the unroasted arabica coffee beans. The increase reached 68.8% conventional one. This showed that the roasting process is essential in forming new Maillard reaction products that influence coffee's antioxidant activity [36]. Antioxidant activities determination by Pokorna J *et al.* 2015 [20] using the DPPH method revealed that methanolic extract of medium roasted Arabica coffee and the robusta coffee had a similar result (113 ± 20 μ mol Trolox/g of sample and 111 ± 10 μ mol Trolox/g of the sample).

Meanwhile, the results for unroasted arabica coffee and the robusta coffee have quite different results (83 ± 18 μ mol Trolox/g of sample and 116 ± 15 μ mol Trolox/g of the sample). Jeszka-Skowron M *et al.* 2016 [18] found that the robusta coffee extract has a more reducing compound than arabica coffee extract when the antioxidant activity is measured CUPRAC method. Green coffee beans from Vietnam showed the highest antioxidant activity (7.49 ± 0.04 mM Trolox/kg). While the most increased antioxidant activity of arabica coffee was obtained from Brazil green coffee beans (5.11 ± 0.17 mM Trolox/kg).

Table 1. Total phenolic content of liberica coffee from three different regions.

Sample	Total Phenolic (g GAE/100 g)		
	n-Hexane Extract	Ethyl Acetate Extract	Ethanol Extract
Riau	1.03 ± 0.05 ^a	2.77 ± 0.09 ^a	17.85 ± 0.50 ^a
Aceh	0.81 ± 0.05 ^b	7.70 ± 0.16 ^b	22.59 ± 1.61 ^b
Jambi	0.78 ± 0.38 ^a	3.38 ± 0.13 ^b	21.26 ± 0.63 ^b

a-c = Different letters in one column indicate a significant difference (p < 0.05)

Total phenolic content (TPC) among various extracts determined using the gallic acid calibration curve equation as gallic acid equivalent (GAE). The calibration curve equation obtained is $y = 0.0056x + 0.0223$, $R^2 = 0.9983$. The TPC in various extracts from three different liberica coffee regions had a different result in the range 0.78 – 22.59 g GAE/100 g. The highest result was given by ethanolic extract of Aceh liberica coffee (A3) (22.59 ± 1.61 g GAE/100 g). The lowest value was given by n-hexane extracts of Jambi liberica coffee (J1) (0.78 ± 0.38 g GAE/100 g) (Table 1).

Similar results are also given by the previous study [35]. The TPC in various extracts from three different arabica coffee expressed results ranged from 0.75 to 70.55 g GAE/100 g. Ethanolic extract of Mandailing arabica coffee showed the highest value (70.55 g GAE/100 g), and the lowest results were given by its n-hexane extract (0.75 g GAE/100 g). These studies showed that ethanolic extract had the highest TPC while the n-hexane extract presented the lowest value.

Saw AK *et al.* 2015 [21] stated that green beans of liberica coffee have the highest TPC, followed by robusta coffee and arabica coffee. However, AAI results using the DPPH method revealed that green beans of liberica coffee have the most increased antioxidant activity, followed by arabica coffee and robusta coffee. This slight difference is due to the lack of the TPC determination method itself, whichever the formed blue complexes. The electron transfer from the phenolic compounds in alkaline medium to molybdenum was not specific. It shows the results from phenolic compounds and the other reducing species like ascorbic acid, aromatic amines, and even sugars can give a positive response [37-40]. The previous study by Mubarak A *et al.* 2019 [23] expressed that TPC from unroasted liberica coffee beans experienced a significant increase in medium-dark liberica coffee beans. Acidri R *et al.* 2020 [17] also showed that arabica coffee, which passed the roasting process, gave higher TPC (35.4 ± 1.49 mg g⁻¹ GAE) than the green bean one (29.3 ± 1.40 mg/g GAE). However, research by Pokorna J *et al.*, 2015 [20] exposed different results.

As a complete result, TPC from coffee beans decreased during the roasting process. Although the TPC from lightly roasted beans 9% higher than the green beans, the TPC then reduced 16% on the medium roasted beans and 30% on the dark roasted coffee beans. From all of the previous studies, it can be exposed that high temperatures and low water level conditions during the roasting process are related to the formation of new Maillard reaction products. The reaction that occurs involved phenolic compounds, which became part of melanoidins [41]. The enhanced result can appear because the increased of formed melanoidins react with the Folin Ciocalteu's reagent [42]. But, during the severe roasting process, the phenolic compound may be degraded [43].

Total flavonoid content (TFC) in various extracts were expressed in quercetin equivalent using the quercetin curve equation $y = 0.0042x + 0.0739$, $R^2 = 0.9911$. The TFC in various extracts from three different regions of liberica coffee had a different result in the range 2.55 – 4.93 g QE/100 g. The highest flavonoid content (4.93 ± 0.36 g QE/100 g) for ethanol

extract of Aceh liberica coffee (A3), while the lowest flavonoid content (2.55 ± 0.21 g QE/100 g) were given by the ethyl acetate extract of Riau liberica coffee (R2) (Table 2).

Table 2. Total flavonoid content of liberica coffee from three different regions.

Sample	Total Flavonoid (g QE/100 g)		
	n-Hexane Extract	Ethyl Acetate Extract	Ethanol Extract
Riau	4.31 ± 0.05^a	2.55 ± 0.21^a	3.78 ± 0.12^a
Aceh	4.56 ± 0.44^a	4.93 ± 0.36^b	3.36 ± 0.09^b
Jambi	2.58 ± 0.25^b	4.71 ± 0.39^b	4.33 ± 0.14^c

a-c = Different letters in one column indicate a significant difference ($p < 0.05$)

The previous study [35] stated that TFC from various extracts of arabica coffee beans from three different regions were in the range of 3.04-7.41 g QE/100 g. Compared with the present study, these arabica green coffee beans have a higher TFC than medium roasted liberica coffee beans. Research by Abdeltaif SA *et al.* 2018 [44] also exposed that raw coffee beans have a higher TFC (52.07 mg catechin/g) than roasted coffee beans (30.65 mg catechin/g).

The correlation between phenolic and flavonoid content in the various extracts of liberica coffee from Riau, Aceh, and Jambi against AAI DPPH and AAI CUPRAC statistically tested using Pearson's method. The TPC and TFC are stated to contribute to antioxidant activity if they positively and positively correlate to AAI DPPH and AAI CUPRAC. This indicated that the higher TPC and TFC display the higher antioxidant activity of the sample.

The data in Table 3 exposed that the phenolic content in various extracts of liberica coffee from Riau, Aceh, and Jambi gave positive and high correlation with the DPPH AAI ($r = 0.998$, $p < 0.01$; $r = 0.885$, $p < 0.01$; $r = 0.993$, $p < 0.01$). Other than that, this study exhibited positive and high correlation between TPC of various extracts of liberica coffee from Riau, Aceh, and Jambi with the CUPRAC AAI ($r = 0.972$, $p < 0.01$; $r = 0.988$, $p < 0.01$; $r = 0.989$, $p < 0.01$). There was no flavonoid content of liberica coffee extracts that positively correlated with AAI DPPH and AAI CUPRAC.

Table 3. Pearson's correlation coefficient of total phenol and flavonoid of liberica coffee from three different regions with AAI DPPH and AAI CUPRAC.

Antioxidant parameter	Pearson's correlation coefficient (r)	
	Total phenol	Total flavonoid
AAI DPPH Riau	0.998**	0.133 ^{ns}
AAI DPPH Aceh	0.885**	-0.915**
AAI DPPH Jambi	0.993**	0.473 ^{ns}
AAI CUPRAC Riau	0.972**	-0.103 ^{ns}
AAI CUPRAC Aceh	0.988**	-0.720*
AAI CUPRAC Jambi	0.989**	0.561 ^{ns}

ns = not significant, * = significant at $p < 0.05$, ** = significant at $p < 0.01$

The structure of these compounds can influence the antioxidant activity provided by phenol group compounds. The more hydroxyl groups in the aromatic ring and the ortho-diphenol structure will strengthen the antioxidant activity [45].

Other than that, the flavonoid compound's antioxidant activity can also be affected by the structure of these compounds [46]. Flavonoids with ortho at-OH groups in C-3'-C-4', OH groups in C-3, ketone groups in C-4, double bonds in C-2, and C-3 will provide high antioxidant activity. However, glycosylated flavonoid compounds will reduce their antioxidant activity because the number of hydroxy groups will also decrease [47].

The correlation between DPPH and CUPRAC AAI in the various liberica coffee extracts from Riau, Aceh, and Jambi were statistically tested using the Pearson method. The data in Table 4 revealed that there were positive and high correlation between AAI DPPH and

AAI CUPRAC in liberica coffee extracts from Riau, Aceh, and Jambi ($r = 0.970$, $p < 0.01$; $r = 0.822$, $p < 0.01$; $r = 0.99$, $p < 0.01$). This result indicated the existence of linear results between the two methods.

Table 4. Pearson's correlation coefficient between DPPH and CUPRAC methods.

Antioxidant parameter	Pearson's correlation coefficient (r)		
	AAI CUPRAC Riau	AAI CUPRAC Aceh	AAI CUPRAC Jambi
AAI DPPH Riau	0.970**		
AAI DPPH Aceh		0.822**	
AAI DPPH Jambi			0.990**

** = significant at $p < 0.01$

4. Conclusions

The determination of the antioxidant activity of liberica coffee from Riau, Aceh, and Jambi demonstrated AAI DPPH in the range of 0.397- 18.536, while CUPRAC 0.532-4.674. The highest TPC in ethanol extract of liberica coffee from Aceh (22.585 ± 1.610 g GAE/100 g) and the highest TFC in ethyl acetate extract of liberica coffee from Aceh (4.927 ± 0.355 g QE/100 g). TPC of all samples had a positive and significant correlation with AAI DPPH and CUPRAC. AAI DPPH and CUPRAC values gave a significant and positive correlation. Ethyl acetate and ethanol extracts of liberica coffee from three different regions were strong to very strong antioxidants. TPC of liberica coffee from three other areas contributed to antioxidant activity by DPPH dan CUPRAC methods. The two methods showed linear results in the antioxidant activities of liberica coffee from three regions.

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Conflicts of Interest

The authors declare no conflict of interest.

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