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ANTIOXIDANT ACTIVITY, TOTAL PHENOL, AND FLAVONOID CONTENT EXTRACTS AND FRACTIONS MANGO SEEDS (*Mangifera indic*a L.)

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ABSTRAK

Antioxidants can either stop or slow down the excessive oxidation of a compound. This study aimed to determine the secondary metabolite compounds, antioxidant activity, total flavonoid and phenolic levels, and the correlation between the levels of flavonoid and phenolic compounds in inhibiting free radicals. The DPPH (1,1-diphenyl-2-picrylhydrazyl) method was used to evaluate antioxidant activity. Determination of total flavonoid levels using a UV-Vis spectrophotometer and the aluminum chloride method. The total phenolic content was determined using the Folin-Ciocalteu method. Based on the results of phytochemical screening, mango seed extract (Mangifera indica L.) contains secondary metabolites such as alkaloids, flavonoids, terpenoids, phenolics, and tannins. The relationship between the antioxidant activity of the DPPH method and total flavonoid levels was 91.31%, respectively. The relationship between the antioxidant activity of the DPPH method and the total phenolic content was 99.64%.

Keywords: *Mangifera indica* L, secondary metabolites, antioxidant activity, DPPH, total flavonoids, total phenolics.

INTRODUCTION

Free radicals are atoms or molecules with unpaired electrons. The presence of unpaired electrons causes a compound or molecule to become more reactive by attacking and binding the electrons of molecules around it to find a partner (Adiprahara *et al*., 2023). Naturally, free radicals can be formed through biological systems of the body and can also originate from the environment. External factors that trigger free radicals include ultraviolet (UV) rays, pollution, cigarette smoke, vehicle emissions, and alcohol (Trijuliamos *et al*., 2022).

By providing free radical molecules with an electron to make them paired and stable, antioxidants are chemicals or compounds that help neutralize free radicals present in the body (Bonita & Taufikurrohmah, 2022). It takes more antioxidants, known as exogenous antioxidants, from outside the body to combat excessive levels of free radicals than the body can produce on its own. Exogenous antioxidants are classified as natural or synthetic based on their source (Sundu *et al*., 2022). Vegetables and vegetable-based diets that are high in beta-carotene, phenolic compounds, and vitamins B and C are good sources of natural antioxidants. However, synthetic antioxidants that aid in oxidation control are also widely available. These include butylated hydroxyanisole (BHA), butylated hydroxyturan (BHT), propyl gallate, and ethoxyquin (Ayuni Hidayah *et al*., 2022). Therefore, it is essential to search for antioxidant-rich sources, such as those derived from salam (plants). Mango plants are among the plants with antioxidant qualities.

Mango (*Mangifera indica* L.), a plant that originated in Southeast Asia, is a common plant in tropical and subtropical regions worldwide. Antioxidants are abundant in mango trees (Ivan Charles *et al*., 2023). Since mango seeds contain chemicals that are known to be

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secondary metabolites, they may find applications in herbal medicine. Organic substances produced by plants that serve as defense mechanisms for plants and may be used in herbal medicine are known as secondary metabolite compounds (N. Sari *et al.*, 2023). In light of the foregoing explanation, further investigation is required to ascertain the total phenolic and flavonoid levels and assess the antioxidant activity of the extracts and fractions of mango fruit seeds using the DPPH method.

RESEARCH METHODOLOGY

Tools and materials

A hot plate (Stuart), rotary vacuum evaporator (Rotavapor R-300), 29 UV-Vis spectrophotometer (Jenway 6800), analytical balance (Precisa XB 220A), rotary vacuum evaporator (Buchi), UV-vis spectrophotometer (Shimadzu), blender (Miyako), and centrifugation. The media used were Mango seeds (Mangifera indica L), technical methanol (Merck), methanol pa (Merck), hydrochloric acid, nitric acid, chloroform, iron (III) chloride, vitamin C (Merck), quercetin (Sigma-Aldrich), gallic acid (Sigma-Aldrich), magnesium, anhydrous acetic acid, sulfuric acid aluminum chloride, potassium acetate, sodium bicarbonate, oxalic acid, sodium hydroxide, monopotassium phosphate, potassium ferricyanide, trichloroacetic acid (Merck), Folin Ciocalteau reagent (Sigma-Aldrich), and DPPH radical (Sigma-Aldrich).

Research Procedures

1. Making mango seed extract

   The extraction process was carried out using the maceration method with a polar solvent, 70% methanol, at a ratio of 1:10. The samples were kept at room temperature for 3 × 24 hours at room temperature and stirred occasionally. The mixture was filtered to separate the remaining mango seed powder from the filtrate. The filtered filtrate was thickened using a rotary evaporator (N. Sari *et al*., 2023)
2. Fractionation

   Fractionation was performed by partitioning a mixture of two solvents with different polarities. The first solvent mixture was a mixture of n-hexane and water (1:1) and the second was a mixture of ethyl acetate and water (1:1). Concentrated using an oven at 70^{o}C (Najihudin *et al*., 2017)
3. Phytochemical Screening
   a. Alkaloids

      A 50 mg sample of mango seed extract was dissolved in 2 N HCl solvent and divided into 4 test tubes. The reagent was then added to each tube. The first tube containing the sample solution was used as a blank. In the second tube, three drops of Dragendroff's reagent, three drops of Mayer's reagent, and three drops of Wagner's reagent were added to the fourth tube. Color changes were also observed. A positive reaction produces an orange precipitate (Harborne, 1996).
   b. Flavonoids

      A total of 1 ml of methanol extract, n-hexane fraction, ethyl acetate fraction, and water fraction of mango seeds were added to 0.2 g of magnesium powder, and 2 mL). Red, orange, and green solutions were formed, indicating the presence of flavonoid compounds (Koch *et al.* 2015).Click or tap here to enter text.
   c. Tannin

      A sample of 50 mg mango seed extract and 10 ml of hot distilled water was placed in a test tube. Two drops of 1% NaCl solution and one drop of 5% gelatin were then added. Samples containing tannins are indicative of the formation of sediments (Harborne, 1996).
   d. Triterpenoids/Steroids

      A 50 mg sample of mango seed extract was dissolved in the appropriate solvent, namely 96% ethanol, and then five drops of Lieberman Bouchardat reagent were added. A color change was observed. A positive reaction forms blue,

green, red, and orange as time increases (Anwar *et al*., 2022).Click or tap here to enter text.

e. Phenolic

A total of 1 mL of mango seed methanol extract, n-hexane fraction, chloroform fraction, ethyl acetate fraction, and water fraction was added to ten drops of 1% FeCl3 if it produced red, purple, blue, or dark black, and the green color indicated that it was positive for phenol (Harbone, 1987).

f. Saponin

Mango seed extract (1 mL) was dissolved in 96% ethanol and added to distilled water in a test tube. The mixture was then shaken vigorously for some time. A positive reaction forms a stable foam within ± 15 minutes (Harborne, 1996).

4. Antioxidant activity test

The antioxidant activity test was carried out using the DPPH method with the comparison compound Vitamin C (Sami & Rahimah, 2016). The test began by making a concentration series, measuring the maximum DPPH wavelength, and determining the operating time(Rastuti *et al*., 2012). The Free Radical Scavenging Activity was determined by the IC_{50} value(Susana *et al*., 2018; Kameliani *et al*., 2020).Click or tap here to enter text.

5. Determination of total flavonoid levels in mango seed extracts and fractions

Determination of total flavonoid levels was carried out using the Visible spectrophotometric method, using Quercetin as a comparator and 10% AlCl3 reagent and 8 mL of 1 M potassium acetate (Sari dan Ayuchecaria, 2017; Aminah, Tomayahu dan Abidin, 2017)

6. Determination of total phenolic content of mango seed extract and fraction

Determination of the total phenolic content was carried out using the UV-Vis spectrophotometric method in accordance with previous research. 1 mL of Folin-Ciocalteu was added to 0.4 mL of the extract solution, shaken, and left for 8 minutes, after which 4 mL of 7% Na_2CO_3 was added, shaken until homogeneous, and distilled water was added until the 10 mL limit mark. The absorbance was read on a spectrophotometer at $\lambda = 750$ nm, and the operating time was 120 minutes (Indah Safitri *et al*., 2023).

Data analysis

Data obtained by determining the antioxidant activity of extracts and seed fractions of mango (*Mangifera indica* L.) using the spectrophotometric method to determine the % inhibition and IC_{50} values were analyzed using a linear regression equation by plotting the concentration (x) and absorbance value obtained from measurements on a spectrophotometer (y). The correlation between the total flavonoid and phenolic content of the extract and mango (*Mangifera indica* L.) seed fraction was analyzed using a linear regression equation between the IC_{50} value (y) and the total flavonoid or total phenolic content (x) of the mango (*Mangifera indica*) extract and seed fraction. L.) so that a regression coefficient is obtained, which shows how much antioxidant activity of the extract and seed fraction of mango (*Mangifera indica* L.) is influenced by the contribution of phenolic compounds and flavonoids.

RESULTS AND DISCUSSION

Dry mango seed powder was macerated by weighing 1000 g of dry mango seed powder, followed by maceration using 6 L of methanol solvent. The maceration method was chosen as the extraction method because its working mechanism is more practical, easy to perform anywhere, simple, and does not require special skills. Methanol was chosen as the solvent because it can attract organic compounds, both polar and nonpolar, and because it has a relatively low boiling point, it is easily separated by evaporation (Suryanto & Irma Momuat, 2017).Click or tap here to enter text.

In the fractionation phase, two types of solvents were used: ethyl acetate and n-hexane. In the n-hexane solvent, the water phase is in the bottom layer while the n-hexane phase is in the top layer, according to the fact that water has a density of 1 g/mL, while n-hexane has a density of 0.6548 g/mL. Meanwhile, the water phase of the ethyl acetate solvent was in the bottom layer, and the ethyl acetate phase was in the top layer, in accordance with the greater density of water (1 g/mL) compared to that of ethyl acetate (0.894 g/mL). Differences in the type of solvent used affected the number of fractions produced. The fractionation results obtained are presented in **Table I**.

Table I. ***Yield of mango seeds (Mangifera indica L.)***

No.	Fraction	Fraction weight	Rendement (%)
1.	n-hexane	3.99 g	3.32 %
2.	Ethyl acetate	17.08 g	14.23 %
3.	Water	98.00 g	81.66 %

Table I shows that the most abundant fractionation results were the water fraction of 98 grams, followed by the ethyl acetate fraction (17.08 grams and the n-hexane fraction (3.99 grams. The high soakage in the water fraction is due to several types of sugars, glycosides, carbohydrates, and saponins, which have complex water-soluble structures with high molecular weights (Suryanto & Irma Momuat, 2017). Thus, it can be concluded that the mango seed samples contained more polar compounds because the weight of the yield was higher in the water fraction.

Phytochemical screening was carried out to identify the secondary metabolite content contained in the methanol extract and mango seed fraction, so that secondary metabolites that have the potential to have antioxidant activity could be identified. The results of the phytochemical screening of the methanol, n-hexane, ethyl acetate, and water fractions are shown in **Table II**.

Table II shows that the methanol, n-hexane, ethyl, and water fractions contained alkaloids, flavonoids, terpenoids, and phenolic compounds. Alkaloid identification resulted in the formation of a brown precipitate in the methanol extract. This outcome is consistent with Harbone's theory, which postulates that the production of a brown precipitate in the Dragendrof test indicates a positive result for alkaloids. In the alkaloid test, a precipitation reaction occurs because of metal replacement. The nitrogen atom has a lone pair of electrons, so it can form coordinating covalent bonds with the metal ions (Harborne, 1987).

Identification is performed by adding concentrated HCl, which hydrolyzes flavonoids into aglycones by hydrolyzing Oglycosyl. H+ replaces glycosyl from the acid because of its electrophilic nature. Reduction with concentrated Mg and HCl can produce complex compounds that are red, green, yellow, or orange in flavonols, flavanones, flavanonols, and xanthones, respectively (Robinson, 1995). The results obtained from the methanol extract, n-hexane fraction, ethyl acetate fraction, and water fraction of mango seeds were red, green, and yellow, respectively. This indicated that the positive sample contained flavonoids.

Table II of phytochemical screening of methanol extract, n-hexane fraction, ethyl acetate fraction, and water fraction of mango seeds.

Testing	Sample	Results	Information
Alkaloids Dragendrof's reagent	Extract	+	Brown precipitate
	n-hexane	+	Brown precipitate
	Ethyl acetate	+	Brown precipitate
	Water	+	Brown precipitate
Flavonoids	Extract	+	The solution is red.
	n-hexane	+	The solution is green.
	Ethyl acetate	+	The solution is yellow.
	Water	+	The solution is yellow.
Terponoid	Extract	+	The solution is brown.
	n-hexane	+	The solution is greenish-black.
	Ethyl acetate	+	The solution is brown.
	Water	+	The solution is brown.
Tannin	Extract	+	The solution is blackish-green
	n-hexane	+	The solution is blackish-green
	Ethyl acetate	+	The solution is blackish-green
	Water	+	The solution is blackish-green
Saponins	Extract	-	No foam is formed.
	n-hexane	-	No foam is formed.
	Ethyl acetate	-	No foam is formed.
	Water	-	No foam is formed.

Results: The Identification of terpenoids in the methanol extract, n-hexane fraction, ethyl acetate fraction, and water fraction yielded positive results, as indicated by the color change to brown, purple, and blackish green when the samples were reacted with sulfuric acid. These results are in accordance with the theory that positive results for terpenoids are characterized by the formation of brown, purple, blackish green, or blackish blue (Mailuhu *et al*., 2017).Click or tap here to enter text. The reaction of terpenoid compounds with H2SO4 and acetic anhydride causes color change. Terpenoid compounds undergo dehydration with the addition of strong acids to form salts, resulting in color changes (Pardede, 2013).

The test results for tannin compounds from the methanol extract, n-hexane fraction, ethyl acetate fraction, and water fraction of mango seeds yielded positive results with the formation of a blackish-green color. These results are based on the theory that a positive tannin test result occurs when a blackish-green color appears. The formation of a blackish-green color after adding $FeCl_3$ According to Setyowati *et al*. (2014), the addition of $FeCl_3$ to the tannin compound test causes a reaction of Fe_3+ ions with the hydroxyl groups in the tannin compound. The results of this reaction caused deep purple and black color changes (N. Sari *et al.*, 2023).

The saponin compound test results showed that the methanol extract, n-hexane fraction, ethyl acetate fraction, and water fraction were damaging, because no stable foam was formed. According to (Robinson 1995), compounds with polar and nonpolar groups are surface-active, so that when saponin is shaken with water, it can form micelles. In the micellar structure, the polar groups face outward, whereas the nonpolar groups face inward. This is what looks like foam.

Antioxidant activity testing was performed quantitatively for the methanol extract, n-hexane fraction, ethyl acetate fraction, and water fraction. Quantitative antioxidant testing

was expressed as the percentage of inhibition of DPPH free radicals. The percentage of inhibition was obtained from the difference between the absorbance of DPPH in methanol and the absorbance of the sample. A linear regression equation was obtained from a graph of the relationship between sample concentration and percent DPPH inhibition, which was used to obtain the IC_{50} (Inhibition Concentration) value. The antioxidant activity was expressed as the concentration that caused a 50% loss of DPPH free radical activity. The smaller the IC_{50} value, the greater the ability of the compound to release free radicals (Oktavia Rahayu *et al*., 2022).Click or tap here to enter text.

To measure the antioxidant activity of the extracts and mango seed fractions using the DPPH method, a UV-Vis spectrophotometer was used to determine the maximum DPPH wavelength and operating time. The aim of determining the maximum wavelength is to read the absorbance of the colored solution sample to be tested and determine the change in absorbance for each concentration series, which is greatest at the maximum wavelength to obtain maximum analytical sensitivity. The results of determining The maximum wavelength of DPPH was 516 nm. Determining the operating time aims to determine the optimum incubation time for the sample to react completely with the DPPH solution (Puspitasari & Indah, 2016). The results of determining the operating time showed stable absorption starting from the 40th minute for DPPH. The DPPH antioxidant activity test results are presented in **Table III**.

Table III. Results of the Antioxidant Activity Test of the DPPH Method for Mango Seeds

Sample	IC_{50} (ppm)			
	I	II	III	X IC_{50} ±SD (ppm)
Vitamin C	6.001	6.326	5.656	5.994 ±0.335
Methanol extract	22.205	22.440	22.385	22.385 ±0.160
n-hexane fraction	19.677	19.570	20.354	19.867 ±0.425
Ethyl acetate fraction	16.498	16.888	16.594	16.594 ±0.260
water fraction	24.143	25.214	24.770	24.709 ±0.538

Table III shows that the methanol extract and mango seed fraction had very strong antioxidant power with an IC_{50} value of <50 ppm. This is in accordance with the theory (Molyneux & Associates, 2004) that antioxidant activity is very strong if the IC_{50} value is less than 50 ppm, which indicates that the sample can inhibit 50 percent of the free radicals at the concentration obtained. Vitamin C is a water-soluble antioxidant that is used as a positive control in antioxidant testing to determine how strong mango seed extracts and fractions are in warding off free radicals when compared to Vitamin C. If the IC_{50} of the sample is the same as or close to the IC_{50} value of the positive control, then the sample has the potential to be used as an alternative antioxidant.

The ethyl acetate fraction showed the strongest antioxidant activity, with an IC_{50} value of 16,594 ppm. This was followed by the water fraction, which had an IC_{50} value of 24,709 ppm; the n-hexane fraction, which had an IC_{50} value of 19,867 ppm; and the methanol extract, which had an IC_{50} value of 22,385 ppm. These findings indicate that mango seeds have strong antioxidant properties because the IC50 values of the water fraction, methanol extract, n-hexane fraction, ethyl acetate fraction, and vitamin C were all less than 50 ppm. Because of its lower IC_{50} value, the ethyl acetate fraction exhibited the highest levels of muscle antioxidant activity. This fraction also had the lowest IC_{50} value. At 16,594 ppm, the ethyl acetate fraction demonstrated its ability suppressed free radicals.

The Folin–Ciocalteu method was employed to determine the total phenolic content. The most popular technique for determining the total phenolic content is this method. Because phenolic substances can react with Folin to generate a solution whose absorbance can be

measured, the Folin–Ciocalteu reagent is utilized. Gallic acid, a naturally occurring stable phenolic compound, is a typical solution. Folin Ciocalteu's reagent reacts with gallic acid to create a yellow color, which indicates the presence of phenolics. Then, as an alkaline agent, the Na_2CO_3 solution is introduced. A blue molybdenum tungsten complex is formed by the hydroxyl group in the phenolic molecule during this process (Tahir *et al*., 2015).

The maximum wavelength was 750 nm. This wavelength was used to measure the absorbance of the calibration curve, extract samples, mango seed fractions, and operating times. After obtaining the maximum wavelength, the operating time was determined to determine the optimum incubation time for the sample with the Folin–Ciocalteu reagent and Na_2CO_3. The results of determining the operating time showed stable absorption starting from the 30th minute. The gallic acid solution was prepared in several series of concentrations, whose absorbance was measured using a UV-Vis spectrophotometer at a wavelength of 750 nm, and a calibration curve was created to determine the relationship between the concentration of gallic acid and its absorbance. Results Total phenolic content is presented in **Table IV**.

Table IV. Results of Total Phenolic Content of Mango Seed Extract and Fraction

Sample	Total Phenolic Content (ppm)			X ±SD (ppm)	(mgEAG/g sample) (X ±SD)
	I	II	III		
Methanol extract	23.421	23.600	25.050	24.024 ±0.893	240.24
n-hexane fraction	38.684	39.600	40.050	39.445 ±0.696	394.45
Ethyl acetate fraction	56.053	56.100	54.550	55.568 ±0.882	555.68
Water fraction	13.421	14.100	15.050	14.190 ±0.818	141.90

In **Table IV**. it is known that the total phenolic content in the ethyl acetate fraction contains the highest phenolic compounds, namely 55,568 ppm with a total phenolic content of 555.68 mgEAG/g sample, then the n-hexane fraction contains 39,445 ppm of phenolic compounds with a total phenolic content of 394 .45 mgEAG/g sample, the methanol extract contains 24,024 ppm of phenolic compounds with a total phenolic content of 240.24 mgEAG/g sample and the water fraction contains 14,190 ppm of phenolic compounds with a total phenolic content of 141.90 mgEAG/g. The total phenolic value for each sample that was determined correlates with the IC_{50} DPPH value of each sample using a linear regression equation shown in **Table IV** and **Figure 1** below.

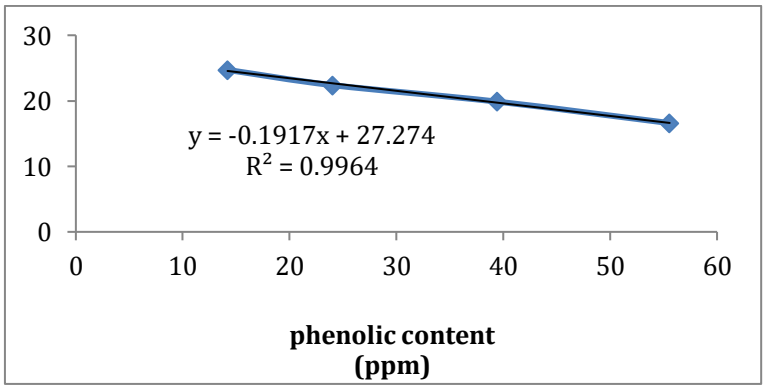

Figure 1. Relationship between total phenolic content and IC_{50} value DPPH method

Based on **Figure 1**, the results of the linear regression between the total phenolic content (x) and the IC_{50} value of the DPPH method (y) extract and mango seed fraction had a regression coefficient of 0.9964 (y = -0.1917x + 27.274). This shows that the contribution of phenolic compounds influences 99.64% of the antioxidant activity of mango seed extracts and fractions, and 0.36% is influenced by compounds other than phenolics. Spectrophotometric absorbance measurements were used in conjunction with the aluminum chloride method to determine the total flavonoid content of mango seed extracts and fractions. The development of a complex between aluminum chloride and the hydroxy and keto groups in flavonoid compounds is the basis of the aluminum chloride method for measuring flavonoid concentration. The 400–800 nm wavelength range was used for the maximum wavelength measurements (Haeria, 2013; Lestari *et al*., 2021). The maximum wavelength of 435 nm was obtained. The methanol extract, n-hexane fraction, ethyl acetate fraction, and water fraction of mango seeds were measured for the total flavonoid absorbance value using the maximum wavelength. After calculating the operation period, stable absorption was achieved after 30 minutes. A UV-Vis spectrophotometer operating at a wavelength of 435 nm was used to measure the absorbance of quercetin standard solutions, which were generated in multiple concentration series. Next, a calibration curve was constructed to represent the relationship between absorbance (y) and quercetin concentration (x). **Table V** displays the total flavonoid level values.

Table V. Results of Total Flavonoid Levels of Mango Seed Extract and Fraction

Sample	Flavonoid Levels (ppm)			X ±SD (ppm)	(mgEK/g sample) (X ±SD)
	I	II	III		
Methanol extract	24.643	26.200	24.500	25.114 ±0.943	251.14
n-hexane fraction	35.357	34.867	40.214	36.813 ±2.956	368,.13
Ethyl acetate fraction	80.357	76.200	79.500	78.686 ±2.195	786.86
Water fraction	16.786	16.200	16.643	16.543 ±0.305	165.43

Based on **Table V** it is known that the total flavonoid content in the ethyl acetate fraction contains the highest flavonoid compounds, namely 78,686 ppm with a total flavonoid content of 786.86 mgEK/g sample, then the n-hexane fraction contains 36,813 ppm flavonoid compounds with a total flavonoid content of 368. 13 mgEK/g sample, the methanol extract contains flavonoid compounds of 25,114 ppm with a total flavonoid content of 251.14 mgEK/g sample and the water fraction contains flavonoid compounds of 16,543 ppm with a total flavonoid content of 165.43 mgEK/g. The total flavonoid content value of each sample that has been determined is correlated with the IC_{50} DPPH value of each sample using a linear regression equation, which can be seen in **Figure 2** and **Table V**

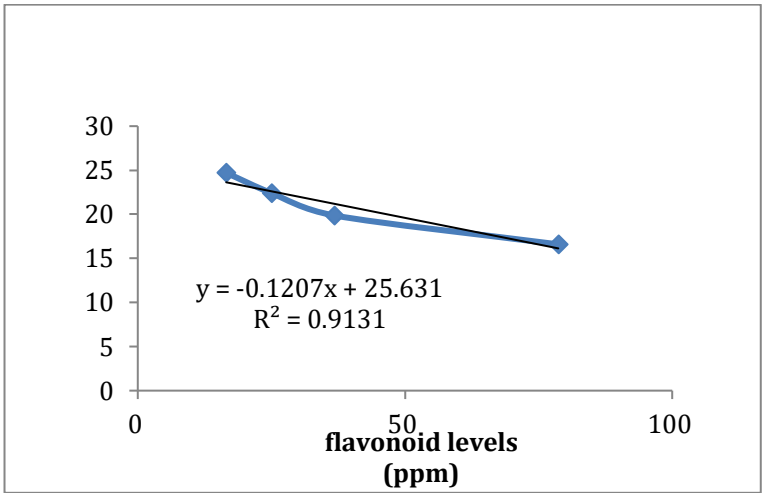

Figure 2. Relationship between total flavonoid levels and IC50 value of DPPH method

Based on **Figure 2** the results of the linear regression between total flavonoid content (x) and the IC_{50} value of the DPPH method (y) extract and mango seed fraction have a regression coefficient of 0.9131 (y = -0.1207x + 25.631). This shows that the contribution of flavonoid compounds influences 91.31% of the antioxidant activity of mango seed extracts and fractions, and 8.69% is influenced by compounds other than flavonoids. Thus, antioxidant activity does not only come from flavonoid compounds but also from other compounds that have antioxidant activity, such as simple phenolic compounds or carotene compounds. This can be influenced by the varieties used in research, sampling location, and harvest time, which can influence flavonoid levels by the formation of active compounds in harvested plant parts (Indah Safitri *et al*., 2023).

CONCLUSION

The secondary metabolite group in mango seed extracts and fractions contains alkaloids, flavonoids, terpenoids, and tannins. The results of the antioxidant activity test using the DPPH method, starting from the methanol extract, n-hexane fraction, ethyl acetate fraction, and water fraction, had very strong antioxidant activity with IC_{50} values of 22.385 respectively 19.867; 16.594, and 24.709 ppm. The total flavonoid content results of the methanol extract, n-hexane fraction, ethyl acetate fraction, and water fraction were 251.14; 368.13; 786.86 and 165.43 mgEK/g sample. The results of the total phenolic content of methanol extract, n-hexane fraction, ethyl acetate fraction and water fraction were 240.24; 394.45; 555.68 and 141.90 mgEAG/g sample. The correlation between the antioxidant activity of the DPPH method and the total phenolic content of the extract and mango seed fraction was 99.64%. The correlation of antioxidant activity with the total flavonoid content of extract and mango seed fraction was found to be 1.31%.

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