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COMPARISON OF FLAVONOID CONTENT AND ANTIOXIDANT ACTIVITY IN LEAF AND PEEL EXTRACTS OF LANGSAT FRUIT (*Lansium domesticum* Corr.) FROM SOUTH KALIMANTAN

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ABSTRACT

Currently, various diseases are developing, ranging from mild to severe. One cause of these various diseases is free radicals. The negative impact of free radicals can be overcome with antioxidant compounds. One type of secondary metabolite with antioxidant activity is flavonoids. The leaves and peel of the langsat fruit (Lansium domesticum Corr.*) are known to contain flavonoids, which can act as antioxidants. The aim of this study was to compare the flavonoid content and antioxidant activity of leaf and peel extracts of langsat fruit (Lansium domesticum Corr.) from South Kalimantan. Antioxidant testing used the DPPH (2-2-Diphenyl-1-Picryhydrazyl) method, and flavonoid levels were determined using UV-Vis spectrophotometry. The total flavonoid content of the langsat leaf extract and langsat fruit peel extract was 28.296 ± 0.092 and 41.09 ± 0.000, respectively. Based on the mean ± SD values, vitamin C, langsat leaf extract, and langsat fruit peel extract exhibited antioxidant activities of 5.46 ± 1.177, 76.416 ± 0.104, and 48.014 ± 1.451, respectively, which were categorized as very strong, strong, and very strong antioxidants.*

Keywords*: antioxidants, flavonoids, Lansium domesticum* Corr

INTRODUCTION

Over time, a broad spectrum of diseases has emerged, ranging from mild to severe conditions. Among these, degenerative diseases remain highly prevalent in the Indonesian population and represent one of the leading public health burdens. Degenerative diseases encompass cardiovascular disorders, heart disease, stroke, diabetes mellitus, and hypertension. The development and progression of these conditions are closely associated with oxidative stress, particularly the excessive generation of free radicals (Kurniawati&Sutoyo, 2021). Free radicals are highly reactive and unstable molecular species characterized by the presence of one or more unpaired electrons. They may originate from stable compounds through oxidative reactions, resulting in molecules with elevated reactivity. When present in excessive concentrations, free radicals can induce cellular damage by attacking nearby biomolecules and abstracting their electrons. In the human body, critical targets of free radical-mediated damage include DNA and proteins, ultimately contributing to the onset and progression of various degenerative diseases (Ramadhan et al., 2020).

The adverse effects induced by free radicals can be mitigated by antioxidant compounds. Antioxidants are substances capable of scavenging or neutralizing free radicals by donating electrons to unstable radical species without disrupting normal metabolic processes in the body. Antioxidant compounds can be naturally obtained from various plant sources found in nature (Ramadhan et al., 2020).

Indonesia possesses a wide diversity of medicinal plants distributed across its many islands. These plants contain various classes of secondary metabolites that offer significant health benefits and therapeutic potential. One important class of secondary metabolites with notable antioxidant activity is flavonoids. In addition to their antioxidant properties, flavonoids play multiple roles in the treatment and prevention of various diseases, including anticancer, anti-inflammatory, antiviral, antimicrobial, antiangiogenic, and antiproliferative activities (Dias et al., 2021;Thalia et al., 2022).

Flavonoids are secondary metabolite derivatives of 2-phenyl-benzyl-γ-pyrone, biosynthesized through the phenylpropanoid pathway, and are characterized by a basic C6–C3–C6 structure. They belong to the phenolic compound class and contain hydroxyl (–OH) functional groups. Flavonoids are widely distributed in all green plants. The antioxidant mechanisms of flavonoids include reducing the formation of reactive oxygen species (ROS), scavenging and neutralizing ROS, as well as modulating and protecting endogenous antioxidant systems (Alfaridz & Amalia, 2018). Flavonoids exert antioxidant activity primarily by acting as free radical scavengers through the donation of hydrogen atoms from their hydroxyl groups, enabling them to bind and neutralize free radicals. The loss of a hydrogen atom induces resonance stabilization within the flavonoid hydroxyl group, thereby lowering its energy state and maintaining molecular stability. Consequently, the stabilized free radicals cease chain reactions, preventing oxidative damage to lipids, proteins, and DNA(Lu et al., 2024).

One plant with potential as a natural antioxidant is langsat (*Lansium domesticum* Corr.). Langsat is a tropical plant that grows in regions such as Indonesia and is a well-known fruit-bearing species in the country. This plant is widely distributed across several Indonesian islands, including Sumatra, Kalimantan, Sulawesi, and Java (Anjasasmara et al., 2020). Empirically, langsat has been used in traditional medicine for the treatment of diarrhea and fever. Previous studies have reported that langsat leaves contain secondary metabolites such as phenolics, saponins, and triterpenoids/steroids (Yunus et al., 2018). Other studies have shown that langsat fruit peels contain secondary metabolites, including flavonoids, tannins, alkaloids, triterpenoids, and saponins (Pratiwi, 2022). The results of this comparison can serve as a basis for further studies, such as biological activity assays, isolation of active compounds, or correlation studies between flavonoid content and specific pharmacological effects.This activity is attributed to the presence of hydroxyl groups on the aromatic rings, which act as electron donors to stabilize and quench free radicals (Senet et al., 2018)

The antioxidant activity in this study was evaluated using the DPPH (2,2-diphenyl-1-picrylhydrazyl) method. This assay was conducted by measuring the decrease in absorbance values. The DPPH method is widely employed for antioxidant activity assessment due to its simplicity, ease of use, rapid execution, high sensitivity, and minimal sample requirement to determine the antioxidant potential of natural compounds (Masrifah et al., 2017). Antioxidant activity is expressed as the IC_{50} (inhibitory concentration), which represents the concentration of a sample required to inhibit 50% of radical activity. A lower IC_{50} value indicates higher antioxidant activity (Masrifah et al., 2017; Nainggolan et al., 2024).

The determination of total flavonoid content was performed using UV–Vis spectrophotometric analysis by measuring absorbance values at the maximum wavelength and subsequently quantifying the flavonoid levels in extracts of langsat leaves and fruit peels. UV–Vis spectrophotometry is widely applied for the analysis of both organic and inorganic substances and offers high analytical accuracy, with an error range of approximately 1–3%. This method enables rapid and precise analysis and is suitable for quantifying very small amounts of compounds. Ultraviolet and visible absorption spectra represent one of the most useful single techniques for the identification of flavonoid structures. Flavonoids possess

conjugated aromatic systems that produce strong absorption bands in the UV–Vis region (Mukhriani et al., 2015;Rohmah et al., 2021).

Based on the above considerations, this study was conducted to compare antioxidant activity using the DPPH (2,2-diphenyl-1-picrylhydrazyl) method and flavonoid content using UV–Vis spectrophotometric analysis in the leaves and fruit peels of langsat (*Lansium domesticum* Corr.) originating from South Kalimantan. The aim of this study was to evaluate and compare the levels of antioxidant compounds and flavonoids present in both the leaves and fruit peels of langsat.

Although several studies have reported the antioxidant activity and secondary metabolite content of Langsat fruit peel. leaves and fruit peels separately, most of these studies remain limited to the evaluation of a single plant part without direct comparative analysis. In addition, comparative data regarding antioxidant activity and total flavonoid content of *Lansium domesticum* Corr. originating from South Kalimantan are still scarce, despite the potential influence of geographical factors on the accumulation of bioactive compounds. Furthermore, langsat fruit peel is generally considered agricultural waste and has not been optimally utilized, even though it may represent a promising source of natural antioxidants with added economic and environmental value. Therefore, a comparative study evaluating the antioxidant activity and total flavonoid content of langsat leaves and fruit peels is necessary to address these limitations, clarify the research gap, and highlight the novelty and urgency of utilizing fruit peel as a value-added natural resource.

METHOD

Study Period and Location

This study was conducted from December 2024 to February 2025 at the Biology and Chemistry Laboratory, Faculty of Health Sciences, Sari Mulia University, Banjarmasin, under laboratory registration number 146/LB.LABDASAR/VI/2024.

Instruments and Materials

The instruments used in this study included a graduated Cylinder (Pyrex), beaker glass (Pyrex), glass funnel (Pyrex), glass stirring rod (Pyrex), horn spoon (local manufacture), spatula (stainless steel, local manufacture), evaporating dish (Pyrex), water bath (Maskot), hot plate (Thermo Scientific), chamber (Camag), filter paper (Whatman No. 1), volumetric flasks (10, 25, and 100 mL; Pyrex), Erlenmeyer flasks (Pyrex), volumetric pipettes (Pyrex), dropper pipettes (Pyrex), test tubes (Pyrex), analytical balance (Acis), maceration container (glass, local manufacture), and a UV–Vis spectrophotometer (Shimadzu).

The materials used in this study consisted of leaf and fruit peel samples of langsat (*Lansium domesticum* Corr.) obtained from South Kalimantan, Ethanol 96% (Merck), analytical-grade ethanol (Merck), distilled water (laboratory grade), magnesium powder (Merck), hydrochloric acid/HCl (Merck), ferric chloride/$FeCl_3$ (Merck), hot water, 10% gelatin solution (Merck), chloroform (Merck), Mayer's reagent (Merck), antimony(III) chloride/$SbCl_3$ (Merck), acetic anhydride (Merck), 10% KOH in methanol (Merck), DPPH (2,2-diphenyl-1-picrylhydrazyl) (Sigma-Aldrich), quercetin (Sigma-Aldrich), 10% $AlCl_3$ (Merck), 5% acetic acid (Merck), Dragendorff's reagent (Merck), and Liebermann–Burchard reagent (Merck).

Preparation of Langsat Leaf Extract Samples

A total of 2 kg of langsat leaves were prepared for extraction. The samples were thoroughly washed with running water and dried in an ovenat 50°C. After drying, the samples

were pulverized using a blender. The extraction process was subsequently carried out using the maceration method. Approximately 995.7 g of powdered langsat leaf simplicia was macerated with 96% ethanol until the solvent level reached 2 cm above the sample for 3 × 24h, with occasional stirring. After the maceration period, the extract was separated into residue and filtrate. The obtained filtrate was then concentrated using a water bath at 50°C to yield a viscous extract (Yunus et al., 2018).

Preparation of Langsat Fruit Peel Extract Samples

Dried langsat fruit peel samples were subjected to an extraction process. The extraction was performed using the maceration method with 96% ethanol as the solvent at a volume of 1 L. The simplicia was placed into a container, followed by the addition of 96% ethanol until the material was completely immersed, with the solvent level approximately 2 cm above the sample. Remaceration was carried out three times to obtain the macerate. The macerate was then separated by filtration and subsequently concentrated using a water bath at 50°C to obtain a viscous extract (Yunus et al., 2018).

Phytochemical Screening (Kemenkes RI, 2022)

1. **Flavonoids**

   One milliliter of langsat leaf and fruit peel extracts was mixed with 1 mg of magnesium powder (Mg) and 3–5 drops of 5 M hydrochloric acid (HCl). A positive flavonoid result was indicated by a color change to red, yellow, or orange.
2. **Saponins**

   One milliliter of langsat leaf and fruit peel extracts was mixed with 10 mL of hot water and vigorously shaken for 10 s. The formation of stable foam with a height of 1–10 cm that persisted for at least 10 min indicated a positive result for saponins.
3. **Tannins**

   One milliliter of langsat leaf and fruit peel extracts was mixed with 5 mL of 10% gelatin solution. The formation of a white precipitate indicated the presence of tannins.
4. **Alkaloid**

   For the langsat leaf extract, 1 mL of extract was treated with 3 drops of Dragendorff's reagent. A positive alkaloid test was indicated by a color change from green to brownish-red. For the langsat fruit peel extract, 1 mL of extract was mixed with 1 mL of 2 N hydrochloric acid and 9 mL of hot water, followed by the addition of 5 drops of Mayer's reagent. The formation of a yellow precipitate indicated the presence of alkaloids.
5. **Steroid**

   One milliliter of langsat leaf extract was treated with 3 drops of Salkowski reagent. A color change from blue to red indicated a positive result. For the langsat fruit peel extract, 1 mL of extract was mixed with 20 mL of chloroform, followed by the addition of 5 drops of Liebermann–Burchard reagent. The formation of a bluish-green ring indicated the presence of steroids.
6. **Triterpenoids**

   One milliliter of langsat leaf extract was treated with 3 drops of $SbCl_3$ and 3 drops of acetic anhydride. A positive result was indicated by a color change from green to pink. For the langsat fruit peel extract, 1 mL of extract was mixed with 20 mL of chloroform, followed by the addition of 5 drops of Liebermann–Burchard reagent. The appearance of an orange or purple ring indicated the presence of triterpenoids.
7. **Glycosides**

   One milliliter of langsat leaf and fruit peel extracts was treated with 3 drops of Liebermann reagent. The formation of a purple ring indicated a positive glycoside test.

8. Anthraquinone

One milliliter of langsat leaf and fruit peel extracts was treated with 3 drops of 10% KOH in methanol. A positive result was indicated by a color change to yellow.

9. Phenolic Compounds

One milliliter of langsat leaf and fruit peel extracts was treated with 3 drops of ferric chloride ($FeCl_3$). A positive result was indicated by a color change to dark green(Aryzki et al., 2024).

Antioxidant Activity Assay(Aiyuba et al., 2023)

1. Preparation of Vitamin C Solution

A total of 10 mg of vitamin C was weighed and transferred into a 100 mL volumetric flask, then ethanol was added to the mark. Serial concentrations of 20, 40, 60, 80, and 100 ppm were prepared by transferring 2, 4, 6, 8, and 10 mL of the stock solution into separate 10 mL volumetric flasks, followed by the addition of ethanol to the mark.

2. Preparation of DPPH Solution

A total of 15.7 mg of DPPH was weighed and dissolved in ethanol in a 100 mL volumetric flask, and the volume was adjusted to the mark.

3. Preparation of Extract Solutions

A total of 10 mg of each extract was weighed and dissolved in ethanol in a 100 mL volumetric flask, and the volume was adjusted to the mark. From this stock solution, serial concentrations of 20, 40, 60, 80, and 100 ppm were prepared by transferring 2, 4, 6, 8, and 10 mL of the solution into separate 10 mL volumetric flasks, followed by the addition of ethanol to the mark.

4. Antioxidant Activity Testing of Langsat Leaf and Fruit Peel Extracts

Two milliliters of each sample solution were transferred into test tubes and mixed with 2 mL of DPPH solution, then shaken until homogeneous. The mixtures were prepared and analyzed in triplicate and incubated for the predetermined operating time, after which the absorbance was measured at a wavelength of 518 nm using a UV–Vis spectrophotometer (Anam et al., 2023)

$$\% \text{ Inhibition} = \frac{A_{Control} - A_{Sample}}{A_{Control}}$$

Explanation:

A Control :absorbance of the DPPH solution without sample

A Sample :absorbance of the DPPH solution in the presence of the sample

Determination of Total Flavonoid Content(Sari et al., 2023)

1. Preparation of 1000 ppm Standard Solution

A total of 10 mg of quercetin was accurately weighed and transferred into a 10 mL volumetric flask, and analytical-grade ethanol was added to the mark to obtain a concentration of 1000 ppm.

2. Preparation of 100 ppm Solution

One milliliter of the 1000 ppm standard solution was transferred into a 10 mL volumetric flask and diluted with analytical-grade ethanol to the mark to obtain a concentration of 100 ppm.

3. Determination of Maximum Wavelength

One milliliter of the 100 ppm solution was mixed with 1 mL of 10% $AlCl_3$ and 8 mL of 5% acetic acid, then transferred into a 10 mL volumetric flask. The maximum wavelength was determined using a UV–Vis spectrophotometer.

4. Determination of Operating Time

One milliliter of the 100 ppm solution was mixed with 1 mL of 10% $AlCl_3$ and 8 mL of 5% acetic acid and transferred into a 10 mL volumetric flask. Absorbance was measured over a 60-minute period until a stable value was achieved.

5. Preparation of Quercetin Calibration Curve

A series of standard solutions with concentrations of 10, 20, 30, 40, and 50 ppm was prepared by transferring 1, 2, 3, 4, and 5 mL of the 100 ppm solution into separate 10 mL volumetric flasks and diluting to volume with analytical-grade ethanol. Each standard solution was prepared and analyzed in triplicate. Subsequently, 1 mL of each standard solution was mixed with 1 mL of 10% $AlCl_3$ and 8 mL of 5% acetic acid and incubated for the previously determined operating time. Absorbance was then measured at the maximum wavelength.

6. Determination of Flavonoid Content in Langsat Leaf and Fruit Peel Extracts

A 1000 ppm extract solution was prepared by dissolving 10 mg of each extract in a 10 mL volumetric flask and diluting to volume with analytical-grade ethanol. A 100 ppm extract solution was then prepared by transferring 1 mL of the 1000 ppm solution into a 10 mL volumetric flask and diluting to volume with analytical-grade ethanol. One milliliter of the 100 ppm extract solution was mixed with 1 mL of 10% $AlCl_3$ and 8 mL of 5% acetic acid, incubated for the predetermined operating time, and the absorbance was measured at the maximum wavelength(Anam et al., 2023).

$$TFC = \frac{C.V}{m}$$

Explanation:
C = Concentration
V = Volume
m = Mass or weight

RESULTS AND DISCUSSION

Phytochemical Screening

Phytochemical screening was conducted to identify the classes of secondary metabolites present in the extracts of langsat leaves and fruit peels. The results of the phytochemical screening of langsat leaf and fruit peel extracts are presented as follows.

Table 1. Results of Phytochemical Screening of Langsat Leaf and Fruit Peel Extracts

No.	Secondary Metabolite Compounds	Langsat Leaves	Langsat Fruit Peels
1.	Flavonoids	+	+
2.	Saponins	-	-
3.	Tanins	+	+
4.	Alkaloids	+	+
5.	Steroids	-	-
6.	Triterpenoids	+	+
7.	Glicosides	-	+
8.	Antraquinones	+	+
9.	Phenolic compound	+	+

Table note:
(+) positive = the presence of the compound class
(−) negative = the absence of the compound class

The phytochemical screening results indicated that the langsat leaf extract contained secondary metabolites, including flavonoids, tannins, alkaloids, triterpenoids, anthraquinones, and phenolic compounds. These findings are consistent with previous studies reporting that

langsat leaf extract contains secondary metabolites such as phenolics, saponins, and triterpenoids/steroids (Yunus et al., 2018).

The phytochemical screening of the langsat fruit peel extract revealed the presence of secondary metabolites, including flavonoids, tannins, alkaloids, triterpenoids, glycosides, anthraquinones, and phenolic compounds. These results are in agreement with earlier research indicating that langsat fruit peel extract contains secondary metabolites such as flavonoids, tannins, alkaloids, triterpenoids, and saponins (Pratiwi, 2022).

The presence of these secondary metabolites suggests that both langsat leaves and fruit peels possess potential as medicinal raw materials and exhibit pharmacological effects in disease treatment. Each class of secondary metabolites plays a crucial role as therapeutic agents through distinct mechanisms of action. Among these compounds, flavonoids are widely recognized for their ability to scavenge free radicals and function as potent antioxidants (Sukweenadhi et al., 2020).

Determination of Total Flavonoid Content

The total flavonoid content was determined using a UV–Vis spectrophotometric method. This analysis aimed to quantify the total flavonoid levels present in langsat leaves and fruit peels. Flavonoid content was calculated using a linear regression equation with quercetin as the reference standard at a maximum wavelength of 413 nm. Quercetin was selected as the standard for total flavonoid determination because it is one of the most effective flavonoid compounds in inhibiting free radicals by preventing various oxidative reactions and stabilizing free radical reactivity(Ramadhan et al., 2020).

From these measurements, it can be concluded that an increase in concentration resulted in a corresponding increase in absorbance. The quercetin standard data were plotted by correlating concentration with absorbance, yielding a linear regression equation of $y = 0.0062x + 0.0038$ with a coefficient of determination (R^2) of 0.9989.

This quercetin calibration curve equation can be used as a reference for determining the total flavonoid content in the extracts of langsat leaves and fruit peels.

Table2. Results of Determination of Total Flavonoid Content

No	Sample	Mean ± SD (mg QE/g)
1.	Langsat leaf extract	28.296±0.092
2.	Langsat fruit peel extract	41.09±0.000

Flavonoids are widely distributed in nearly all parts of plants, including fruits, roots, leaves, and the outer bark. Flavonoids are natural compounds with strong antioxidant potential, capable of scavenging free radicals that contribute to the development of degenerative diseases through mechanisms such as impairment of the immune system and the oxidation of lipids and proteins. Flavonoid subclasses that exhibit antioxidant activity include flavones, flavonols, catechins, and chalcones(Ulfah et al., 2024).

The results of total flavonoid content determination indicated that the langsat fruit peel extract contained the highest flavonoid level, at 41.09 mg QE/g, compared with the langsat leaf extract, which contained 28.296 mg QE/g. Total flavonoid content plays a crucial role in inhibiting free radicals; therefore, higher total flavonoid levels are associated with stronger antioxidant activity in plant materials (Nainggolan et al., 2024).

Total flavonoid content (TFC) alone does not always directly reflect the biological activity of an extract because flavonoids comprise a structurally diverse class of compounds whose antioxidant and other bioactivities are strongly dependent on their specific chemical structures. For example, differences between aglycone and glycoside forms influence both antioxidant potential and metabolic behavior: aglycones often exhibit higher intrinsic radical-scavenging power due to free phenolic hydroxyl groups, while glycosylated flavonoids may show altered stability, solubility, and metabolic fate, affecting how much activity is retained

during digestion or in vitro assays such as DPPH or ABTS. Recent studies demonstrate that structural differences among flavonoid O-glycosides, C-glycosides, and their corresponding aglycones lead to distinct antioxidant activities and stability profiles during in vitro digestion and in vivo metabolism, underscoring that content alone is insufficient to predict bioactivity without considering structure–activity relationships(Ghozzi et al., 2024).

In addition to flavonoids, other non-flavonoid phenolic compounds—such as phenolic acids (e.g., hydroxybenzoic and hydroxycinnamic acids), tannins, and stilbenes—are important contributors to overall antioxidant and biological activities. These non-flavonoid polyphenols possess structural features that enable effective free-radical scavenging, metal chelation, and inhibition of oxidative reactions, and they are often present in plant extracts alongside flavonoids. Their contribution can be significant, and in some cases comparable to or synergistic with flavonoids, especially when total phenolic content (TPC) correlates more strongly with measured antioxidant activity than TFC alone (Galić et al., 2025).

Antioxidant Activity Assay

Antioxidant activity was evaluated using the DPPH method, with absorbance measured by UV–Vis spectrophotometry. This assay was conducted to determine the levels of antioxidant compounds present in langsat leaves and fruit peels. The results of the antioxidant activity assay of langsat leaf and fruit peel extracts are presented as follows.A statistically significant difference in IC_{50} values was observed between the leaf and fruit peel extracts of langsat (sig< 0.050).

Table3. Results of Antioxidant Activity Assay

No.	Sample	Mean ± SD	Category
1.	Vitamin C	5.46±1.177	Very strong
2.	Langsat leaf extract	76.416±0.104	Strong
3.	Langsat fruit peel extract	48.014±1.451	Very strong

The results of the antioxidant activity assay demonstrated that DPPH absorbance decreased with increasing concentrations of the tested extracts. This indicates that the extracts were able to scavenge DPPH free radicals, leading to a reduction in DPPH concentration as reflected by the decreased absorbance. The percentage of inhibition obtained was used to determine the IC_{50} (inhibitory concentration) values of vitamin C and each extract. Antioxidant activity was expressed as IC_{50}, which represents the concentration of a sample required to inhibit 50% of DPPH free radical activity.However, it should be noted that the DPPH assay measures only radical scavenging capacity and does not represent all antioxidant mechanisms. The IC_{50} values were determined based on the percentage of inhibition calculated from the absorbance of the DPPH solution before and after the addition of a series of sample concentrations, followed by linear regression analysis expressed as y = a + b(Nainggolan et al., 2024).

Based on the conducted assays, the IC_{50} values were determined to be 5.46 ppm for vitamin C, 76.416 ppm for the langsat leaf extract, and 48.014 ppm for the langsat fruit peel extract. These values indicate the antioxidant activity level of each sample. An IC_{50} value below 50 ppm indicates very strong antioxidant activity; an IC_{50} value between 50 and 100 ppm indicates moderate antioxidant activity; an IC_{50} value between 100 and 150 ppm indicates weak to moderate antioxidant activity; and an IC_{50} value above 150 ppm indicates weak antioxidant activity (Nainggolan et al., 2024).

Vitamin C, used as the reference standard, exhibited the strongest IC_{50} value among all tested samples. This is because the antioxidant activity of vitamin C has been well established, with an IC_{50} value of 5.46 ppm which falls within the very strong antioxidant category. Vitamin C, also known as ascorbic acid, is one of the most commonly used antioxidants; it is

water-soluble and readily available from various dietary sources. Chemically, vitamin C is capable of reacting with most free radicals and oxidants present in the body (Yimcharoen et al., 2019). As an antioxidant, vitamin C effectively neutralizes oxidative stress through electron donation or transfer mechanisms, donating electrons to prevent the oxidation of other compounds and scavenging superoxide anions, hydroxyl radicals, and lipid hydroperoxides(Caritá et al., 2020;Sukweenadhi et al., 2020)

Based on the IC_{50} values of each extract, the langsat fruit peel extract exhibited stronger antioxidant activity than the langsat leaf extract. The langsat fruit peel extract showed an IC_{50} value of 48.014 ppm, which falls into the very strong antioxidant category, whereas the langsat leaf extract exhibited an IC_{50} value of 76.416 ppm, categorized as strong antioxidant activity. Both langsat leaf and fruit peel extracts demonstrated antioxidant activity in scavenging free radicals. Secondary metabolites, particularly flavonoid compounds present in the leaves and fruit peels of langsat, play a crucial role in determining the antioxidant activity of the extracts.The presence of glycosidic compounds, especially flavonoid glycosides, in fruit peel extracts can contribute to higher antioxidant activity through several interrelated mechanisms. Glycosylation—the attachment of sugar moieties to flavonoid aglycones—significantly improves the physicochemical properties of flavonoids by increasing their water solubility and stability, which enhances their extractability and persistence in aqueous systems such as DPPH assays. Recent research highlights that glycosylated flavonoids often display improved stability against degradation and maintain functional activity under in vitro conditions compared to non-glycosylated forms, enabling more sustained radical scavenging capacity during assays and potentially in vivo contexts (Lai et al., 2025).

CONCLUSION

This study demonstrated differences in both flavonoid content and antioxidant activity between leaf and peel extracts of langsat fruit (*Lansium domesticum* Corr.) from South Kalimantan. The total flavonoid content of the langsat leaf extract and langsat fruit peel extract was 28.296 ± 0.092 and 41.09 ± 0.000, respectively. Based on the mean ± SD values, vitamin C, langsat leaf extract, and langsat fruit peel extract exhibited antioxidant activities of 5.46 ± 1.177 ppm, 76.416 ± 0.104 ppm, and 48.014 ± 1.451 ppm, respectively, which were categorized as very strong, strong, and very strong antioxidants. Overall, the langsat fruit peel extract demonstrated higher antioxidant activity and total flavonoid content compared to the leaf extract, indicating its greater potential as a natural antioxidant source.

REFERENCES

Alfaridz, F., & Amalia, R. (2018). Review Jurnal : Klasifikasi dan AktivitasFarmakologidariSenyawaAktif Flavonoid. *Farmaka*, *16*(3), 1–9.

Aiyuba, D. S., Rakhmatullah, A. N., & Restapaty, R. (2023). Uji Aktivitas Antioksidan Ekstrak Metanol Daun Ramania (*Bouea macrophylla* Griffith.) Menggunakan Metode DPPH: Antioxidant Activity Test of Methanol Extract of Ramania Leaf (*Bouea macrophylla* Griffith.) Using the DPPH method. *Jurnal Surya Medika (JSM)*, *9*(1), 81–87.

Anam, S., Hartanti, D. A. S., Chusnah, M., &Puspaningrum,Y. (2023). Uji Kandungan Flavonoid Dan Tanin Pada Ekstrak Daun Dan Kulit Pohon Kayu Mahoni (*Swietenia mahagoni*). *Jurnal Buana Sains*, *23*(1), 41-44

Anjasasmara, Suriyanti, & Alimuddin, S. (2020). Identifikasi Karakter Morfologi Tanaman Langsat (*Lansium domesticum* Corr) Sebagai Buah Unggul Lokal di Kabupaten Polewali Mandar Provinsi Sulawesi Barat. *Jurnal AGrotekMAS*, *1*(3), 26–42.

Aryzki, S., Gaghauna, E. E. M., & Kusuma, C. A. (2024). Toxicity Test of Fixed Dose Method on Ethanol Extract of Ramania Leaves (*Bouea macrophylla* Griffith.) from South Kalimantan. *Jurnal Mandala Pharmacon Indonesia*, *10*(2), 664–672.

Caritá, A. C., Fonseca-Santos, B., Shultz, J. D., Michniak-Kohn, B., Chorilli, M., & Leonardi, G. R. (2020). Vitamin C: One compound, several uses. Advances for delivery, efficiency and stability. In *Nanomedicine: Nanotechnology, Biology, and Medicine* (Vol. 24). Elsevier Inc.

Dias, M. C., Pinto, D. C. G. A., & Silva, A. M. S. (2021). Plant flavonoids: Chemical characteristics and biological activity. In *Molecules*, 26(17). MDPI.

Galić, L., Lončarić, Z.,& Lisjak, M. (2025). A Review of Phenolic Compounds: From Biosynthesis and Ecological Roles to Human Health and Nutrition. *Phyton*, *94*(11), 3297.

Ghozzi, I., Fontaine, J. X., Molinié, R., Elboutachfaiti, R., Akkouche, L., Sebei, K., & Quéro, A. (2024). Relationship Between the Structure of the Flavone C-Glycosides of Linseed (*Linum usitatissimum* L.) and Their Antioxidant Activity. *Molecules*, *29*(24), 5829.

Kementerian Kesehatan Republik Indonesia. (2022). *Suplement I Farmakope Herbal Indonesia* Edisi II. Jakarta: Kementerian Kesehatan Republik Indonesia.

Kurniawati, I. F., & Sutoyo, S. (2021). Review Artikel: Potensi Bunga Tanaman Sukun (*Artocarpus altilis* [Park. I] Fosberg) Sebagai Bahan Antioksidan Alami. *Journal of Chemistry*, *10*(1), 1–11.

Lai, X., Li, X., Chen, J., Liu, X., Pan, P., Zhou, Y., & Zhao, G. (2025). Advances in flavonoid glycosylation: Chemical and biological basis, mechanisms, physicochemical properties, and applications in the food industry. *Trends in Food Science & Technology*, 105296.

Lu, L., Luan, Y., Wang, H., Gao, Y., Wu, S., & Zhao, X. (2024). Flavonoid as a Potent Antioxidant: Quantitative Structure–Activity Relationship Analysis, Mechanism Study, and Molecular Design by Synergizing Molecular Simulation and Machine Learning. *J. Phys. Chem. A*, *128*, 6216–6228.

Masrifah, Rahman, N., &Abram, P. H. (2017). Uji Aktivitas Antioksidan Ekstrak Daun dan Kulit Labu Air (*Lagenaria siceraria* (Molina) Standl.). *J. Akad. Kim, 6(2),* 98-106.

Nainggolan, R. M., Rahayu, M. P., & Rejeki, E. S. (2024). Uji Aktivitas Antioksidan, Kadar Flavonoid, dan Fenolik Total Ekstrak dan Fraksi Daun Asam Jawa(*Tamarindus indica* L.). *Jurnal Mandala Pharmacon*,*10*(2), 397–410.

Mukriani, Nonci, F. Y., & Munawarah, S. (2015). *Analisis Kadar Flavonoid Total Pada Ekstrak Daun Sirsak (Annona muricata* L*.) Dengan Metode Spektrofotometri Uv-Vis*.

Pratiwi, D. (2022). Uji Aktivitas Antibakteri Ekstrak Etanol Kulit Buah Duku (*Lansium domesticum* Corr) Terhadap Bakteri *Salmonella typhi*. *Jurnal Medistra Medical Journal (MMJ)*, *1*(1), 29–33.

Ramadhan, H., Baidah, D., Lestari, N. P., & Yuliana, K. A. (2020). Aktivitas Antioksidan Ekstrak Etanol 96% Daun, Buah dan Kulit Terap (*Artocarpus odorratissimu*s) Menggunakan Metode Cuprac. *Farmasains: Jurnal Ilmiah Ilmu Kefarmasian*, *7*(1), 7–12.

Rohmah, S. A. A., Muadifah, A., & Martha, R. D. (2021). Validasi Metode Penetapan Kadar Pengawet Natrium Benzoat pada Sari Kedelai di Beberapa Kecamatan di Kabupaten Tulungagung Menggunakan Spektrofotometer UV-Vis. *Jurnal Sains Dan Kesehatan*, *3*(2), 120–127.

Sari, K. R. P., Ikawati, Z., Danarti, R., & Hertiani, T. (2023). Micro-titer plate assay for measurement of total phenolic and total flavonoid contents in medicinal plant extracts. *Arabian Journal of Chemistry*, *16*(9), 105003.

Senet, M. R. M., Raharja, I. G. M. A. P., Darma, I. K. T., Prastakarini, K. T., Dewi, N. M. A., & Parwata, I. M. O. A. (2018). Penentuan Kandungan Total Flavonoid Dan Total Fenol Dari Akar Kersen *(Mutingia calabura)* Serta Aktivitasnya Sebagai Antioksidan.*Jurnal Kimia*, *12*(1), 13–18

Sukweenadhi, J., Yunita, O., Setiawan, F., Kartini, Siagian, M. T., Danduru, A. P., & Avanti, C. (2020). Antioxidant activity screening of seven Indonesian herbal extract. *Biodiversitas*, *21*(5), 2062–2067.

Thalia, C. U., Nathania, C., Sukweenadhi, J., Goretti, M., & Purwanto, M. (2022). Profile and Antioxidant Capacity of Phenolic Compounds from Rice Straw. *Indonesian Journal of Biotechnology and Biodiversity*, *6*(1), 10–17.

Ulfah, A., Nastiti, K., Kurniawati, D., & Hakim, A. R. (2024). Penetapan Kadar Flavonoid Dan Aktivitas Antioksidan Esktrak Etanol Daun Bangkal (*Nauclea subdita* (Korth) Menggunakan Spektrofotometri UV-Vis. *Journal of Pharmaceutical Care and Scienc*, *5*(1), 29–39.

Yimcharoen, M., Kittikunnathum, S., Suknikorn, C., Nak-on, W., Yeethong, P., Anthony, T. G., & Bunpo, P. (2019). *Effects of ascorbic acid supplementation on oxidative stress markers in healthy women following a single bout of exercise*. 1–9.

Yunus, I., Boddhi, W., & Queljoe, E. De. (2018). Skrining Fitokimia dan Uji Toksisitas Ekstrak Etanol Daun Langsat (*Lansium domesticum* Corr) Terhadap Larva Artemia salina Leach dengan Metode Brine Shrimp Lethality Test (BSLT). *Pharmacon Jurnal Ilmiah Farmasi*, *7*(3), 89–96.