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*Research Article*

# Antioxidant Activity, Total Phenolics, and Total Flavonoids Content of Bajakah Tampala (*Spatholobus littoralis*): The Indigenous Herbal Medicine from Kalimantan

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Total flavonoid content
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## Abstract

Bajakah tampala (*Spatholobus littoralis*), a medicinal plant traditionally used in Indonesia, particularly on Kalimantan Island, has garnered interest for its potential health benefits. However, scientific evidence remains scarce. This study investigated the antioxidant activity of *S. littoralis* extract and its total phenolic and flavonoid content. Ethanol extraction and evaporation were used to prepare the extract. The DPPH method assessed antioxidant activity, while Folin–Ciocalteu and $AlCl_3$ complexation methods quantified total phenolics and flavonoids, respectively. The *S. littoralis* extract exhibited strong antioxidant activity with an $IC_{50}$ value of 54.19 ± 8.15 µg/mL. Additionally, the extract contained substantial levels of phenolics (0.649 ± 0.026% GAE) and flavonoids (1.084 ± 0.043% QE). These findings suggest a link between the high phenolic and flavonoid content of *S. littoralis* extract and its observed strong antioxidant activity.

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## INTRODUCTION

Borneo or Kalimantan Island, renowned for its vast tropical rainforests, is a hotspot of plant biodiversity in Southeast Asia, rivaling even the Amazon. This diverse ecosystem provides a natural habitat for a wide array of medicinal plants, including *Spatholobus littoralis* Hassk, which is commonly found in the island's interior and forested areas[1,2]. *Spatholobus littoralis*, commonly known as *bajakah tampala*, is a native plant found in Kalimantan, Indonesia. This plant has been traditionally used by the Dayak people for generations as a remedy for various ailments[3,4]. The Dayak culture encompasses a rich tradition of utilizing medicinal plants, and *S. littoralis* is one such example[5,6].

*Spatholobus littoralis*, a promising medicinal plant, has demonstrated antioxidant, anti-inflammatory, anticancer, and antibacterial properties in previous studies[7-11]. These findings suggest its potential for development as a widely applicable traditional medicinal preparation. Previous research[8] has identified several secondary metabolites in *S. littoralis*, including 3,7-trihydroxyflavone, eriodictyol, plantymenin, dihydroquercetin, butin, neoisoliquiritigenin, dihydrokaempferol, liquiritigenin, and 6-methoxyeriodictyol. These compounds may contribute to the plant's therapeutic effects.

Antioxidants play a crucial role in preventing the progression of degenerative diseases, including diabetes, hypertension, dyslipidemia, and cardiovascular disease[12,13]. Free radicals, reactive oxygen species that can damage cellular components like lipids, proteins, and DNA, contribute to various health issues, including degenerative diseases, premature aging, inflammation, and even tumor formation[14]. While the human body naturally produces antioxidants to combat free radicals,

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excessive oxidative stress can necessitate external antioxidant supplementation. Phenolic and flavonoid compounds have been identified as potent antioxidants but remain understudied[15,16]. This study aims to investigate the antioxidant activity of *S. littoralis* extract and determine its correlation with total phenolic and flavonoid content.

## MATERIALS AND METHODS

### *Materials*

*Spatholobus littoralis* plant samples were collected from Banjarmasin, South Kalimantan during 2023. The plant specimens were authenticated by a botanist at the Laboratory of Biological Education, Universitas Lambung Mangkurat, and assigned the voucher specimen number 074/UN8.1.2.3.2/PG/Lab.PMIPA/Bio/2023.

### *Methods*

*Extract preparation*

*Spatholobus littoralis* powders were extracted using ethanol in a 1:10 sample-to-solvent ratio. The maceration process was repeated with fresh ethanol to maximize extract yield. The obtained extract was concentrated using a rotary evaporator at 50°C.

*Antioxidant activity assay*

The antioxidant activity of the *S. littoralis* extract was evaluated using the DPPH (1,1-diphenyl-2-picrylhydrazyl) free radical scavenging assay[17]. A series of *S. littoralis* extract concentrations were added to a DPPH solution. The antioxidant compounds within the extract donated hydrogen atoms to the DPPH free radicals, resulting in a reduction of the DPPH radical. This reduction was quantified by measuring the decrease in absorbance at 517 nm. The antioxidant activity was expressed as the $IC_{50}$ value, which represents the concentration of the extract required to inhibit the DPPH radical by 50%[18].

*Total phenolic content assay*

The total phenolic content (TPC) of the *S. littoralis* extract was quantified using a spectrophotometric method with gallic acid as a standard. The extract was oxidized with Folin-Ciocalteu reagent, resulting in a blue-purple color change. The absorbance of the resulting solution was measured at 765 nm using a spectrophotometer[19].

*Total flavonoid content assay*

The total flavonoid content (TFC) of the plant extracts was determined using the aluminum chloride ($AlCl_3$) colorimetric method. This method involves the reaction between flavonoids and $AlCl_3$, resulting in the formation of a colored complex[20]. The intensity of the yellow color produced was measured spectrophotometrically at 510 nm. Quercetin was used as a standard.

### *Data analysis*

The $IC_{50}$ values were determined by correlating the sample concentration with the percentage inhibition. The TPC was expressed as a percentage of gallic acid equivalent (GAE). The TFC was expressed in terms of quercetin equivalents (QE).

## RESULTS AND DISCUSSION

As depicted in **Figure 1**, *S. littoralis* exhibits a cylindrical, unbranched stem with a greenish-brown color and a diameter of 3.2 cm. The leaves are simple, alternate, pinnately compound, with an inverted triangular shape, smooth surface, flat edges, and a pointed tip, measuring 6 cm in length and 2.4 cm in width. The flowers are monoecious, arranged in fistulous inflorescences with 5 cm flower stalks, possessing four calyxes and a color spectrum ranging from white to red.

### *Antioxidant activity assay*

The antioxidant activity of *S. littoralis* ethanol extract was evaluated using the DPPH free radical scavenging assay. As illustrated in **Figure 2**, the extract demonstrated potent antioxidant activity, with an $IC_{50}$ value of 54.19 ± 8.15 µg/mL. This value falls within the range of 50-100 µg/mL, characteristic of strong antioxidants[21]. The antioxidant properties of *S. littoralis*

may contribute to the prevention of oxidative stress, which is associated with various degenerative diseases[22]. By reducing oxidative stress, this plant extract could potentially mitigate the progression of these diseases.

The DPPH assay is a widely employed method for assessing the antioxidant potential of plant-based extracts. It relies on the ability of compounds to scavenge free radicals, reducing the DPPH radical. In this study, compounds capable of scavenging and reducing DPPH radicals were considered antioxidants. A higher extract concentration generally correlates with increased antioxidant activity[23].

a b

**Figure 1.** Morphology of (**a**) stem and (**b**) leaf of *S. littoralis*.

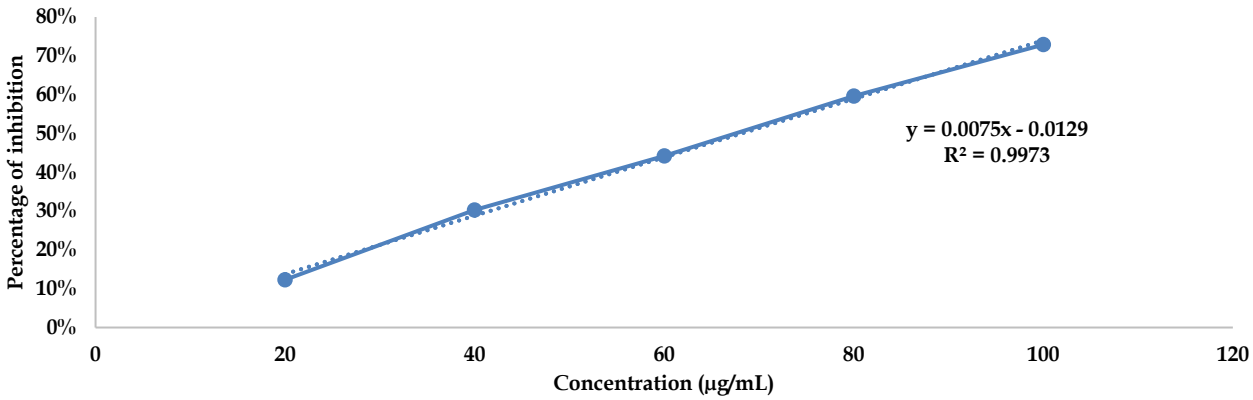


**Figure 2.** Antioxidant activity of *S. littoralis* extract.

### *Total phenolic content*

The total phenolic content of the *S. littoralis* extract was determined to be 0.649 ± 0.026 %GAE as shown in **Figure 3**. This finding is consistent with previous reports from Central Kalimantan, which identified a phenolic content of 0.7 %GAE in *S. littoralis*[24]. Interestingly, the geographical origin of *S. littoralis* did not significantly influence its total phenolic content.

The presence of phenolic compounds, including flavonoids, phenols, terpenoids, and cardiac glycosides, is likely responsible for the strong antioxidant activity exhibited by the *S. littoralis* extract[25]. The high phenolic content in this extract is directly correlated with its potent antioxidant properties, as demonstrated in previous studies[24]. These phenolic compounds have also been shown to contribute to the cytotoxic and anti-inflammatory effects of *S. littoralis* extract[9].

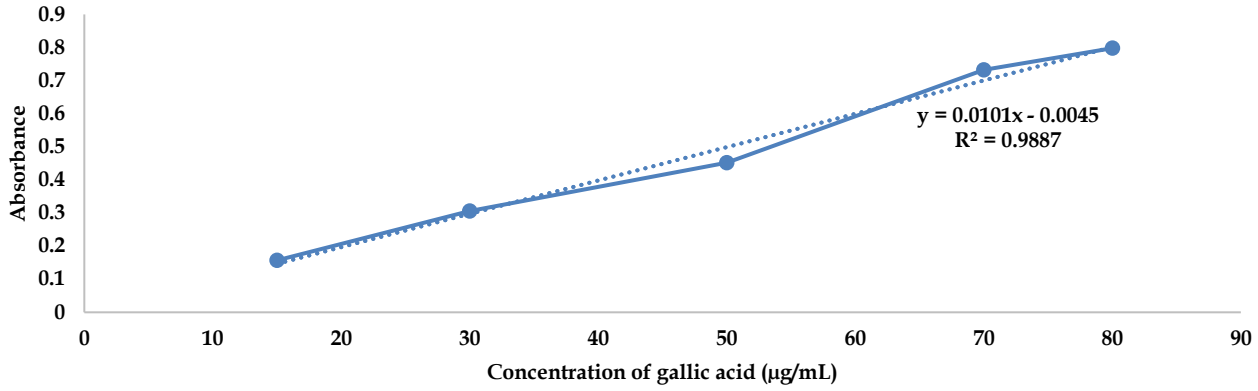


**Figure 3.** Gallic acid standard curve for determination of total phenolic content of *S. littoralis* extract.

### *Total flavonoid content*

The antioxidant activity, total phenolic content, and total flavonoid content of *S. littoralis* extract were determined and presented in **Table I**. Flavonoids, known for their antioxidant properties, are prevalent in herbal medicines[26]. The conjugated double bonds and hydroxyl groups within flavonoid compounds contribute to their electron-donating capacity, enabling them to act as free radical scavengers.

The total flavonoid content in *S. littoralis* extract was quantified using quercetin as a standard, expressed as %QE. The standard curve for quercetin is depicted in **Figure 2**. The results indicate a total flavonoid content of 1.084 ± 0.043 %QE in *S. littoralis* extract. Previous research has reported that the leaves of *Uncaria acida*, another member of the Rubiaceae family, exhibit the highest flavonoid content compared to other plant parts[27]. This finding underscores the importance of preserving the leaves of *S. littoralis* for potential medicinal applications. While the Dayak people traditionally utilize the roots of *S. littoralis*, our findings suggest that the leaves may be a more valuable source of flavonoids. This information could inform future research and potential commercialization efforts.

**Table I.** Antioxidant activity, total phenolic, and total flavonoid contents of *S. littoralis* extract.

| Parameter | Value |
|---|---|
| Antioxidant activity ($IC_{50;}$ µg/mL) | 54.19 ± 8.15 |
| Total phenolic content (%GAE) | 0.649 ± 0.026 |
| Total flavonoid content (%QE) | 1.084 ± 0.043 |

The results of this study demonstrate the significant antioxidant capacity of *S. littoralis* extract as evaluated by the DPPH method. Flavonoids and phenolic compounds, known for their hydroxyl group, are key contributors to this antioxidant activity[8]. While the DPPH method provides valuable insights, further confirmation of *S. littoralis* extract's antioxidant activity through additional *in vitro* assays is warranted. The ABTS and FRAP methods could be employed to assess antioxidant capacity using different mechanisms[28]. Moreover, *in vivo* studies investigating the impact of *S. littoralis* extract on endogenous antioxidant enzymes such as superoxide dismutase (SOD), catalase (CAT), and glutathione peroxidase (GPx) are essential to fully elucidate its antioxidant potential[29].

## CONCLUSION

This study demonstrates the potent antioxidant activity of *S. littoralis* extract against DPPH free radicals. This activity can be attributed to the extract's high concentrations of phenolic and flavonoid compounds, which were quantified at 0.649 ± 0.026 %GAE and 1.084 ± 0.043 %QE, respectively. These findings highlight the potential of *S. littoralis* as a valuable source of natural antioxidants for various applications.

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## AUTHORS' CONTRIBUTION

**Conceptualization**: Nurkhasanah Mahfudh, Siti Nashihah, Andika
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**Project administration**: Nurkhasanah Mahfudh, Siti Nashihah
**Resources**: Siti Nashihah, Andika
**Software**: -
**Supervision**: Nurkhasanah Mahfudh
**Validation**: Nurkhasanah Mahfudh, Dwi Utami, Mustofa Ahda, Siti Nashihah, Andika
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**Writing - review & editing**: Nurkhasanah Mahfudh, Siti Nashihah

## DATA AVAILABILITY

None.

## CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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