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# PHYTOCHEMICAL PROFILE AND ANTIOXIDANT ACTIVITY OF SARGASSUMBERS. EXTRACT FROM THE WATERS OF SUMBERKIMA VILLAGE, BALI

Profil Fitokimia Dan Aktivitas Antioksidan Ekstrak *Sargassum* sp. dari Kawasan Perairan Desa Sumberkima, Bali

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## ABSTRACT

*Sargassum* sp. is a type of brown seaweed that contains secondary metabolites. This study aims to identify the phytochemical compounds and antioxidant activity of *Sargassum* sp. seaweed extract from the waters of Sumberkima Village, Bali. Extraction was carried out using a maceration method using distilled water at room temperature. Phytochemical compound analysis was carried out through phytochemical screening to identify secondary metabolites and testing for antioxidant activity using the DPPH (1,1-*diphenyl* 2-p*icrylhydrazyl*) method. The results showed that the Sargassum sp. extract contained secondary metabolites in the form of phenols, flavonoids, and tannins, but secondary metabolites in the form of saponins, alkaloids, and terpenoids were not detected. The antioxidant activity test yielded an $IC_{50}$ value of 5461.58 ppm, which is categorized as very weak. However, the presence of phenols, flavonoids, and tannins indicates that the *Sargassum* sp. extract from the waters of Sumberkima Village still has potential as a bioactive compound. Therefore, further study through optimization of extraction and purification methods is needed to increase the biological activity of the compounds contained.

**Keywords**: *Sargassum sp*., antioxidants, phenols, flavonoids, tannins.tanin.

## ABSTRAK

*Sargassum* sp. merupakan jenis rumput laut cokelat yang memiliki kandungan metabolit sekunder. Penelitian ini bertujuan untuk mengidentifikasi senyawa fitokimia dan aktivitas antioksidan ekstrak rumput laut *Sargassum* sp. dari kawasan perairan Desa Sumberkima, Bali. Ekstraksi dilakukan dengan metode maserasi menggunakan pelarut akuades dengan suhu ruang. Analisis senyawa fitokimia dilakukan melalui skrining fitokimia untuk mengidentifikasi kandungan metabolit sekunder, serta pengujian aktivitas antioksidan menggunakan metode DPPH *(1,1 diphenyl 2-picrylhidrazyl)*. Hasil penelitian menunjukkan bahwa ekstrak *Sargassum* sp. positif mengandung metabolit sekunder berupa fenol, flavonoid dan tanin, tetapi metabolit sekunder berupa saponin, alkaloid, dan terpenoid tidak terdeteksi. Uji aktivitas antioksidan menghasilkan nilai $IC_{50}$ sebesar 5461,58 ppm yang termasuk kategori

sangat lemah. Meskipun demikian, keberadaan senyawa fenol, flavonoid, dan tanin menunjukkan bahwa ekstrak *Sargassum* sp. dari kawasan perairan Desa Sumberkima tetap memiliki potensi sebagai senyawa bioaktif, sehingga diperlukan kajian lebih lanjut melalui optimasi metode ekstraksi dan pemurnian untuk meningkatkan aktivitas biologis senyawa yang terkandung.
**Kata Kunci** : *Sargassum* sp., antioksidan, fenol, flavonoid, tanin.

## INTRODUCTION

Seaweed is a marine biological resource with significant potential for use in various fields, such as food, pharmaceuticals, cosmetics, and aquaculture (Torres-Narváez *et al*., 2025). As an archipelagic nation, Indonesia boasts a rich diversity of seaweed species and is one of the world's largest seaweed producers, with production contributing the highest globally after China (Basyuni *et al*., 2024). One type of seaweed commonly found in Indonesian waters is *Sargassum* sp., which belongs to the brown seaweed group (*Phaeophyceae*) (Sulistiyani *et al*., 2022).

*Sargassum* sp. is known to contain various secondary metabolites with potential biological benefits, such as phenols, flavonoids, tannins, alkaloids, saponins, and terpenoids. According to research by Rushdi *et a*l. (2020), these compounds exhibit biological activities as antioxidants, antibacterials, antivirals, anti-inflammatory agents, and immunostimulants. The presence of these secondary metabolites makes *Sargassum* sp. as a natural source of materials that have the potential to be developed to support the health of cultivated organisms and the needs of marine resource-based industries (Wang *et al*., 2025). Antioxidants are compounds that play a role in inhibiting oxidation reactions through free radical scavenging mechanisms, thereby reducing the risk of cell and tissue damage caused by oxidative stress (Tumilaar *et a*l., 2024). The accumulation of excessive amounts of free radicals can cause oxidative stress that contributes to various biological disorders. Therefore, the search for natural antioxidant sources continues as a safer and more environmentally friendly alternative to synthetic antioxidants. One source of natural antioxidants that has received much attention is seaweed, particularly the genus *Sargassum* (Harfiyani *et al*., 2026).

Figure 1. *Sargassum* sp.
(Source: Personal Documentation)

The antioxidant activity of *Sargassum* sp. is generally related to the presence of phenolic, flavonoid, and tannin compounds. These compounds act as free radical scavengers through electron and hydrogen atom transfer mechanisms. Research by Catarino et al. (2023) shows that the secondary metabolite content and antioxidant activity of *Sargassum* sp. can vary depending on the species, environmental conditions, growing location, harvest age, extraction method, and solvent type used. These differences in factors contribute to the bioactive potential of seaweed from each region (Catarino *et al*., 2023).

Sumberkima Village, Gerokgak District, Buleleng Regency, Bali, is a coastal area with significant seaweed resource potential. This region boasts aquatic conditions that support the growth of various marine organisms, including *Sargassum* sp. (Yuspita *et al*., 2022). Based on a literature search, publications on the phytochemical profile and antioxidant activity of Sargassum sp. extracts from the waters of Sumberkima Village are still limited, requiring further study. Most previous studies have focused on *Sargassum* sp. from other locations using extraction methods using organic solvents such as ethanol and methanol, while relatively few studies have used distilled water (Edison *et al*., 2020).

Based on this description, this study was conducted to identify phytochemical compounds and determine the levels of secondary metabolites in the form of phenols, flavonoids, tannins, saponins, alkaloids, and terpenoids. It also aimed to determine the antioxidant activity of Sargassum sp. extracts from the waters of Sumberkima Village, Bali. The results of this study are expected to provide scientific information regarding the characteristics of local *Sargassum* sp. phytochemical compounds and serve as baseline data for further research on its use as a natural antioxidant source.

## RESEARCH METHODS

Sampling of *Sargassum* sp. seaweed was conducted in October 2025 in the waters of Sumberkima Village, Gerokgak District, Buleleng Regency, Bali Province. The research locations were determined at two observation stations selected purposively based on the presence and abundance of *Sargassum* sp. in the cultivation area.

The samples used in this study were *Sargassum* sp. seaweed obtained from both observation stations. Sampling was carried out by selecting healthy, intact thallus, free from physical damage, and having reached mature size based on morphological observations.

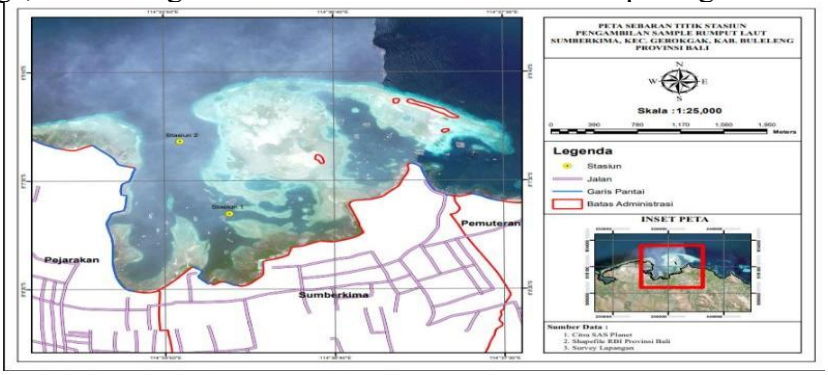


Figure 2. Location of *Sargassum* sp. Sampling.

The sample extraction process was conducted in the Fisheries Biotechnology Laboratory, Ganesha University of Education. The extraction results were then concentrated using a rotary evaporator in the Forensic Laboratory, Udayana University. Further testing, including phytochemical screening and antioxidant activity, was conducted at the Integrated Services Laboratory, Faculty of Agricultural Technology, Udayana University.

The sample preparation stage was carried out using the air-drying method at room temperature in a shaded area, away from direct sunlight, to maintain the stability of the thermolabile bioactive compounds. Once completely dry, the samples were chopped and ground using a blender to form a powder (simplicia). The powder was then sieved to obtain a homogeneous particle size and stored in an airtight container until used in the extraction process.

The extraction process of *Sargassum* sp. was carried out using the maceration method with distilled water as the solvent. A total of 50 g of Sargassum sp. powder was macerated

using 500 mL of distilled water (1:10 m/v) for 24 hours at room temperature to extract secondary metabolites. Next, the mixture was heated using a hotplate stirrer at 80°C for 30 minutes to increase the solubility of the bioactive compounds contained in the macerated *Sargassum* sp. liquid extract. After cooling, the sample was filtered using Whatman grade 4 filter paper, then the filtrate was evaporated with a rotary evaporator at ±60°C until a thick extract was obtained.

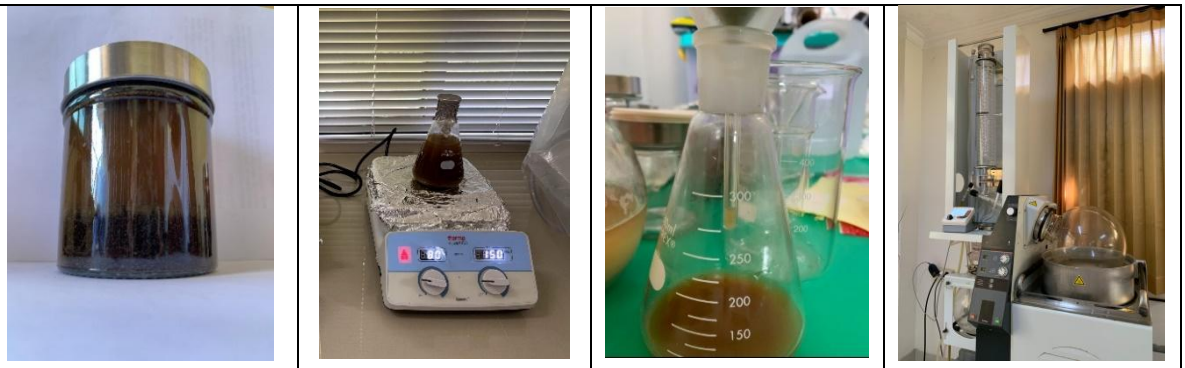


Figure 3. Stages of the Extraction Process

Phytochemical screening tests, including phenol, flavonoid, tannin, saponin, alkaloid, and terpenoid levels, as well as antioxidant activity, were conducted at the Integrated Services Laboratory of the Faculty of Agricultural Technology, Udayana University, by laboratory staff in accordance with the laboratory's Standard Operating Procedures (SOP).

Phenol content analysis was performed using the Folin-Ciocalteu method. A 0.1 g extract sample was dissolved in 85% methanol, then centrifuged, and the filtrate used for analysis. A 0.4 mL sample was reacted with Folin-Ciocalteu reagent, incubated, then 5% sodium carbonate was added, and incubated for another 90 minutes in the dark. Absorbance was measured at 760 nm using a spectrophotometer. Phenol content was calculated based on a standard curve of gallic acid.

Flavonoid content analysis was performed using the $AlCl_3$ colorimetric method. The extract sample was dissolved in 50% ethanol, then centrifuged, and the filtrate used as the test solution. A 1 mL sample solution was reacted with 1 mL of 2% $AlCl_3$ solution and incubated for 30 minutes. Absorbance was measured using a spectrophotometer at a wavelength of 415 nm. Flavonoid levels were determined based on a quercetin standard curve.

Tannin levels were analyzed using the Folin-Denis method using tannic acid as a standard. The extract sample was reacted with Folin-Denis reagent and 5% $Na_2CO_3$, then incubated for 30 minutes. Absorbance was measured at a wavelength of 725 nm using a spectrophotometer, and tannin levels were calculated based on a tannic acid standard curve.

Saponin analysis began by dissolving 0.5 g of the extract in 70% ethanol, then adding distilled water and vigorously shaking. A positive saponin result was indicated by the formation of a stable foam on the surface of the solution after shaking.

Alkaloid analysis was performed by dissolving 0.5 g of the extract in 70% ethanol, then adding 2N HCl and heating. After a cloudy solution or precipitate formed, a few drops of iodine reagent were added. A positive result for alkaloids was indicated by the formation of an orange to brick-red precipitate.

Terpenoid analysis was performed by dissolving 0.5 g of the extract in 70% ethanol, then adding chloroform and acetic anhydride. After cooling, the mixture was reacted with

concentrated sulfuric acid. A positive result for terpenoids (triterpenoids) was indicated by the formation of a reddish color at the interface between the solution layers.

Antioxidant activity was analyzed using the DPPH (*1,1-diphenyl 2-picrylhydrazyl*) method. The test was performed by dissolving the extract in 99.9% methanol, then making serial dilutions at concentrations of 0, 2, 4, 6, 8, and 10 mg/L. Each solution was reacted with 3.5 mL of 0.1 mM DPPH and incubated for 30 minutes in the dark. Next, absorbance was measured using a spectrophotometer at a wavelength of 517 nm to determine the $IC_{50}$ value.

## RESULTS

### Phytochemical Screening Test Results

Phytochemical compound content analysis was conducted through a phytochemical screening test to identify the presence of secondary metabolites in Sargassum sp. extract obtained from the waters of Sumberkima Village, Bali. The test results showed that the extract contained several groups of secondary metabolites, namely phenols, flavonoids, and tannins. Each compound was detected in different amounts, indicating variations in the composition of secondary metabolites in the Sargassum extract. The presence of these compounds indicates biological potential that can contribute to the functional activity of seaweed, including as a source of natural antioxidants.

Table 1 Phytochemical Compound Content of *Sargassum* sp. Extract.

| No | Compounds | Total Content (mg/100 g) | Description |
|---|---|---|---|
| 1 | Phenols | 213.88 | Positive (+) |
| 2 | Flavonoids | 105.87 | Positive (+) |
| 3 | Tannins | 10.66 | Positive (+) |
| 4 | Saponins | Not Found | Negative (-) |
| 5 | Alkaloids | Not Found | Negative (-) |
| 6 | Terpenoids | Not Found | Negative (-) |

### Antioxidant Activity Test Results

Analysis of the antioxidant activity of *Sargassum* sp. extract was carried out using the DPPH (*1,1-diphenyl-2-picrylhydrazyl*) test method, which is based on the ability of antioxidant compounds to reduce free radicals. The test results showed that the Sargassum sp. extract had an $IC_{50}$ value of 5461.58 ppm.

Table 2 Results of Antioxidant Activity Test of *Sargassum* sp. Extract.

| No | Sample | Test Method | $IC_{50}$ value (ppm) | Activity Category |
|---|---|---|---|---|
| 1 | *Sargassum* sp. | DPPH | 5461,58 | Very Weak |

Based on the analysis results, the Sargassum sp. extract from the waters of Sumberkima Village was proven to contain phytochemical compounds in the form of phenols, flavonoids, and tannins. In contrast, saponin, alkaloid, and terpenoid compounds were not identified in the tested extract. Antioxidant activity testing using the DPPH method resulted in an $IC_{50}$ value of 5461.58 ppm, indicating that the extract's ability to quench free radicals is classified as very weak. However, the presence of phenol, flavonoid, and tannin compounds indicates that the *Sargassum* sp. extract still has potential as a source of bioactive compounds that can provide certain biological activities.

## DISCUSSION

The results showed that the Sargassum sp. extract from the waters of Sumberkima Village contained 213.88 mg/100 g of phenolic compounds, 105.87 mg/100 g of flavonoids, and 10.66 mg/100 g of tannins. Conversely, saponins, alkaloids, and terpenoids were not identified in the tested extract. The presence of phenolic, flavonoid, and tannin compounds indicates that Sargassum sp. contains secondary metabolites with the potential to provide various biological activities, particularly as natural antioxidants.

Phenolic compounds are one of the main bioactive components found in brown algae. These compounds contain hydroxyl groups that can donate hydrogen atoms to free radicals, thereby inhibiting oxidation reactions (Rushdi *et al*., 2020). According to Julianto (2019), phenolic compounds act as natural antioxidants due to their ability to stabilize free radicals through electron and hydrogen atom transfer mechanisms. The phenolic content obtained in this study indicates that the *Sargassum* sp. extract is a natural antioxidant. from the waters of Sumberkima Village has the potential as a source of natural antioxidant compounds.

The flavonoid content of 105.87 mg/100 g in Sargassum sp. extract also confirms the presence of a group of polyphenol compounds that have potential as natural antioxidants. Flavonoids are known to inhibit the formation of Reactive Oxygen Species (ROS) through electron transfer mechanisms and hydrogen atom donation to free radicals, thereby breaking the oxidation chain reaction. The presence of these bioactive components indicates that *Sargassum* sp. has the potential to be used as a natural ingredient source in the development of functional food products, pharmaceuticals, and aquaculture (Helena & Sanjayasari, 2018).

The tannin content of 10.66 mg/100 g also confirms the presence of a group of polyphenols that contribute to antioxidant activity. Tannins can neutralize free radicals through hydrogen donation mechanisms and form complexes with proteins and metal ions that play a role in the oxidation process (Sabela *et al*., 2025). Although lower in content than phenols and flavonoids, the presence of tannins still contributes to the extract's bioactivity profile. These results indicate that phenols and flavonoids are the more dominant bioactive components in *Sargassum* sp. extract. obtained using distilled water as a solvent.

The antioxidant activity of phenol, flavonoid, and tannin compounds is related to the presence of hydroxyl groups (-OH) in their chemical structure (Prasedya *et al*., 2021). These groups are capable of donating hydrogen atoms and electrons to free radicals, thereby stabilizing them and making them less reactive. Phenolic compounds work through hydrogen atom transfer (HAT) and single electron transfer (SET) mechanisms, which can halt oxidation chain reactions. Flavonoids have similar, if not more effective, abilities because their aromatic ring structure allows for electron delocalization, thus stabilizing the formed flavonoid radicals. Meanwhile, tannins, a group of polyphenols with multiple hydroxyl groups, are capable of binding and neutralizing free radicals and inhibiting oxidation processes through chelating prooxidant metal ions (Li *et al*., 2020). Therefore, the presence of phenols, flavonoids, and tannins in Sargassum sp. extract contributes to the potential antioxidant activity of this seaweed.

Phytochemical screening results showing no detection of saponins, alkaloids, and terpenoids can be influenced by various factors, such as seaweed species, growing conditions, harvest age, extraction method, and the type of solvent used. Riskiana & Vitta (2021) stated that the type of solvent has a significant influence on the bioactive compounds successfully extracted from Sargassum sp. The use of aquadest as a solvent tends to extract polar compounds so that not all secondary metabolites can be dissolved and detected in the resulting extract.

The antioxidant activity of *Sargassum* sp. extract tested using the DPPH method yielded an $IC_{50}$ value of 5461.58 ppm. Based on the antioxidant activity classification, this value falls into the very weak category. The $IC_{50}$ value reflects the extract concentration required to inhibit 50% of DPPH free radicals. The lower the $IC_{50}$ value, the higher the antioxidant capacity of a

substance in scavenging free radicals. The results obtained indicate that although *Sargassum* sp. extract contains phenolic compounds, flavonoids, and tannins, its antioxidant capacity is still relatively low (Husni *et al*., 2022).

The results of this study indicate a significant phenomenon: the phenol content in Sargassum sp. extract is relatively high (213.88 mg/100 g), but its antioxidant activity remains in the very weak category with an $IC_{50}$ value of 5461.58 ppm. This finding indicates that high total phenolic content does not always directly correlate with an extract's antioxidant capacity. These differences are thought to be caused by several factors, including the low DPPH free radical scavenging capacity of the phenolic compounds present, the low concentration of truly active antioxidant compounds, and the possible degradation of some bioactive compounds during the extraction and concentration processes. Furthermore, the effectiveness of antioxidant activity is not solely determined by the total phenolic content but is also influenced by the chemical structure, stability, and bioactivity of each phenolic compound contained in the extract.

The low antioxidant activity in this study is likely related to the use of distilled water as the extraction solvent. Aqua has a different extraction capacity than organic solvents such as methanol, ethanol, and ethyl acetate, which are commonly used to obtain antioxidant compounds from seaweed. Some bioactive compounds that contribute to antioxidant activity are known to be more soluble in organic solvents, resulting in lower amounts of active compounds successfully extracted using distilled water. Furthermore, antioxidant activity is also influenced by environmental factors such as geographic conditions, light intensity, salinity, water temperature, nutrient availability, and seaweed harvest age (Lopes *et al*., 2024).

The results of this study differ from those of Erniati *et al*. (2024), who reported that several Sargassum species from Simeulue waters exhibited strong antioxidant activity with an $IC_{50}$ value of 74.7 µg/mL. This difference indicates that the bioactive characteristics of seaweed are strongly influenced by the species used, habitat conditions, and extraction method applied. Nevertheless, the presence of phenolic compounds, flavonoids, and tannins in the extract of Sargassum sp. from the waters of Sumberkima Village shows that this seaweed still contains secondary metabolites that have the potential to be further developed through optimization of extraction methods and the use of more suitable solvents to increase the yield of bioactive compounds and their antioxidant activity.

## CONCLUSION

Based on the research results, the extract of Sargassum sp. from the waters of Sumberkima Village, Bali contains phenol compounds of 213.88 mg/100 g, flavonoids of 105.87 mg/100 g, and tannins of 10.66 mg/100 g, while saponins, alkaloids and terpenoids were not detected. The results of the DPPH method antioxidant activity test showed an $IC_{50}$ value of 5461.58 ppm which is categorized as very weak. The high $IC_{50}$ value indicates that the bioactive compounds contained in the extract have not been able to provide effective free radical scavenging activity. Nevertheless, the presence of phenol, flavonoid, and tannin compounds indicates that Sargassum sp. still has potential as a source of natural secondary metabolites that can be further developed through optimization of extraction methods and purification of active compounds.

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