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Study on the Chemical Composition and Antioxidant Activities of *Amorphophallus sp* and *Amorphophallus Tuberculatus*

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ABSTRACT

Two species of the genus *Amorphophallus*, *Amorphophallus tuberculatus* and *Amorphophallus sp*, have not yet been studied. Therefore, their glucomannan content, chemical compositions, and biological activities were studied in our research. Results showed that the glucomannan content in fresh tubers of *Amorphophallus sp* ranged from 22.19% to 27.73%, while no glucomannan was detected in *A. tuberculatus*. The leaf and tube samples were extracted using ethanol-water (70%) as the solvent, and the chemical composition was analyzed using preliminary qualitative methods and FTIR spectroscopy. Antioxidant activities were evaluated through DPPH radical scavenging and ferric reducing antioxidant power (FRAP) assays, which showed that both species exhibited weak antioxidant activities, with IC_{50} values greater than 100 µg/mL for DPPH and EC_{50} values above 1.0 mg/mL for FRAP. The chemical composition included flavonoids, saponins, tannins, alkaloids, and polysaccharides, which were identified using preliminary qualitative methods and FTIR spectroscopy. These findings provide fundamental data on the two species' chemical composition and biological activities, highlighting their potential applications in pharmaceuticals and functional foods, particularly the exploitation of glucomannan as a health-promoting ingredient.

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1. Introduction

The genus *Amorphophallus* of the family Araceae comprises a diverse group of plants with significant ecological and economic importance. These plants are predominantly distributed in tropical and subtropical regions such as Southeast Asia, Japan, and China, where they contribute to local ecosystems and economies. With over 200 species identified globally, *Amorphophallus* plays a vital role in biodiversity, while its unique properties and composition make it a valuable resource in traditional foods, herbal medicine, and industrial applications [1]. In Vietnam, approximately 25 species of *Amorphophallus* have been recorded, with notable examples such as *Amorphophallus konjac*, *A. paeoniifolius*, *Amorphophallus sp* , and *A. tuberculatus* [2]. These species are recognized for their high nutritional content and potential applications in food, health, and other industries [3]. Among the most studied compounds is glucomannan, a water-soluble, non-ionic polysaccharide primarily extracted from the corms of *Amorphophallus* species such as *A. konjac*. It is composed of β-1,4-linked D-mannose and D-glucose units in a ratio of about 1.6:1 and exhibits exceptional gel-forming ability, high viscosity, and biocompatibility. Glucomannan has received extensive attention for its clinically validated health effects, including: cholesterol-lowering activity through enhanced bile acid excretion, Improvement of glycemic control by slowing glucose absorption, and support for weight management due to its high satiety effect and low caloric content [4]. Despite this focus, research has predominantly emphasized *A. konjac* and *A. paeoniifolius*, leaving the chemical and biological potential of other species, especially those native to Vietnam, underexplored. Notably, the lesser-known species *Amorphophallus sp* and *A. tuberculatus* have received limited scientific attention despite their presence in diverse ecological zones such as Dong Nai and Quang Binh provinces.

The limited scope of previous research highlights a significant gap in understanding the broader chemical and biological potential of *Amorphophallus*. Most existing studies have primarily concentrated on glucomannan content, often overlooking other valuable compounds such as polyphenols, flavonoids, and alkaloids, which are known for their antioxidant and therapeutic properties [2]. Furthermore, the antioxidant activities of these species, essential for applications in health-supportive products, remain largely unexplored. Addressing this gap, this study aims to expand the knowledge of the chemical composition and biological activities of *Amorphophallus sp* and *A. tuberculatus*, which are endemic to Vietnam and potentially valuable for sustainable exploitation.

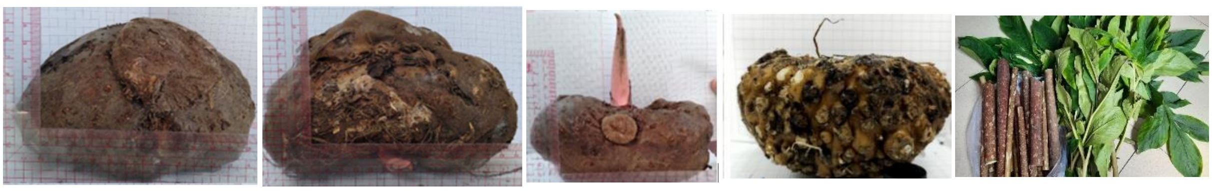
The primary objectives of this research include quantifying glucomannan content, analyzing chemical components using advanced techniques such as Fourier-transform infrared spectroscopy (FTIR), and evaluating antioxidant activities through DPPH and FRAP assays. These methods allow for a comprehensive understanding of the chemical and functional properties of these species. Additionally, this study represents the first detailed investigation of *Amorphophallus sp* and *A. tuberculatus* in Vietnam, providing foundational data to support their sustainable utilization and conservation [5].

By revealing the chemical richness and biological potential of these species, the findings can guide their integration into the food, pharmaceutical, and cosmetic industries. For instance, glucomannan's high gel-forming ability positions it as a promising natural ingredient for functional food development, while polyphenols and flavonoids from these plants can contribute to antioxidant-rich formulations in nutraceuticals and skincare products [6]. Moreover, this research aligns with global efforts to promote sustainable resource use, ensuring that native plant species are both preserved and utilized effectively. By addressing the chemical and biological attributes of *Amorphophallus sp* and *A. tuberculatus*, this study provides a valuable contribution to the growing body of knowledge on *Amorphophallus* species and their potential roles in promoting sustainable development.

2. Materials and Methods

2.1. Materials and chemicals

The study utilized samples from two species of the genus *Amorphophallus*: *Amorphophallus sp* and *Amorphophallus tuberculatus*. For *Amorphophallus sp*, three tubers of various sizes were collected from Dong Nai province, Vietnam. The tuber samples were categorized as follows: C3-MC1-1 (18.5 × 10.5 × 9.5 cm; C3-MC1-2 (20.5 × 15 × 13 cm), and C3-MC1-3 (20.5 × 13 × 10 cm) (Figure 1). For *Amorphophallus sp*, tuber was collected from Quang Binh province, with a diameter of 12 × 10 × 6 cm (C3-MC2) (Figure 1). The collected materials were pre-processed by cleaning, slicing, and drying to the appropriate moisture levels before storage for experimentation. In addition, to compare the compositions and antioxidant activity, C3-MC-TL was obtained from the leaves of *Amorphophallus sp* (Figure 1).



C3-MC1-1 *Amorphophallus sp*	C3-MC1-2 *Amorphophallus sp*	C3-MC1-3 *Amorphophallus sp*	C3-MC2 *A. tuberculatus*	C3-MC-TL *Amorphophallus sp*

Figure 1. *Amorphophallus sp and Amorphophallus tuberculatus samples.*

The chemicals used in this study were sourced from reputable suppliers and include standards and primary solvents: Catechine, 2,2-diphenyl-1-picrylhydrazyl (DPPH), gallic acid (Sigma-Aldrich, USA), Ascorbic acid and formic acid (Merck, Germany), acetonitrile for HPLC (Scharlau. Tây Ban Nha), ethanol (Chemsol, Vietnam). Other chemicals: aluminum chloride, sodium bisulfite, sodium hydroxide, and sodium nitrite were collected from Xilong Chemical, China.

2.2. Sample Preparation

2.2.1. Powder Preparation

Freshly harvested *Amorphophallus* tubers were thoroughly washed to remove soil and debris, then air-dried for approximately 20–30 minutes before preparing powder [7]. The tubers were weighed and manually peeled to remove the outer skin. The inner core was sliced into thin sections of 2–3 mm thickness and immediately immersed in a 0.2‰ sodium bisulfite ($NaHSO_3$) solution to prevent enzymatic browning. After soaking, the slices were removed and subjected to a two-step drying process: initially at 100°C for 30 minutes, followed by drying at 60°C until completely dehydrated. The dried material was then ground into a fine powder with a particle size of approximately 400–500 µm, yielding the dried *Amorphophallus* tuber powder. This powder was used for subsequent analyses of moisture content and glucomannan content.

2.2.2. Extract preparation

Dried *Amorphophallus* tuber and leaf powders were extracted using a hydroethanolic solvent system (70% ethanol) [8]. The sample-to-solvent ratio was maintained at 1:2 (w/w). The mixtures were kept at room temperature for 24 hours, with stirring (2–3 times per day) to enhance extraction efficiency. After the initial extraction period, the supernatant was collected and stored, while the remaining solids were re-extracted with fresh solvent under the same conditions. This extraction process was repeated three times until the final extract appeared nearly colorless, indicating exhaustive extraction. The combined extracts were filtered and concentrated using a rotary evaporator at 50°C under reduced pressure to remove the solvent, yielding a crude extract. The crude extracts were stored in a cool, dry place, preferably under refrigeration, until further analysis. Moisture content, extraction yield, chemical composition, and antioxidant activity of the crude extracts were subsequently determined.

2.2.3. Determination of Moisture Content

The moisture content of the raw materials was determined following the AOAC Official Method 925.10 [9]. Approximately 2–5 g of the prepared sample (tuber or leaf powder) was accurately weighed into a pre-dried and pre-weighed moisture dish. The sample was then dried in a hot-air oven at 105 ± 2°C for 3 hours, or until a constant weight was achieved. After drying, the sample was cooled in a desiccator for 30 minutes and weighed again. The moisture content was calculated using the following formula:

$$\text{Moisture content (\%)}=((W_1-W_2)/W1)\times 100$$

where: W_1 = Initial weight of sample before drying (g); W_2 = Final weight of sample after drying (g)

2.2.4. Determination of Glucomannan Content in Tubers

The glucomannan content in tubers was quantified using the 3,5-dinitrosalicylic acid (3,5-DNS) method, which measures the absorbance of reducing sugars (D-glucose and D-mannose) released after hydrolysis. The absorbance was recorded at 550 nm using a UV-Vis spectrophotometer. Standard glucose solutions ranging from 16 to 80 µg/mL were prepared to establish a calibration curve. The samples were hydrolyzed with 3M H_2SO_4 at 100°C for 150 minutes and subsequently neutralized with 6M NaOH. The absorbance of the resulting solutions was measured, and the glucomannan content was calculated using the glucose calibration curve and relevant conversion factors [10].

2.2.5. Qualitative Identification of Functional Groups by chemical reactions and FT-IR spectroscopy

The identification of bioactive compound groups was conducted using specific chemical reactions to detect the presence of flavonoids, saponins, alkaloids, amino acids, polysaccharides, and tannins [11]. These groups were determined based on observable color changes or the formation of precipitates during the reactions. For flavonoids, the samples were treated with 1% NaOH or $FeCl_3$, leading to the formation of distinct colored complexes. Saponins were identified through foam stability tests, while alkaloids were detected using Bouchardat’s reagent, which produced reddish-brown precipitates. Polysaccharides were confirmed by the application of Lugol’s reagent, resulting in a characteristic blue-black color. Additionally, the Fourier-transform infrared (FTIR) spectroscopy technique was utilized to identify functional groups in the extracts by recording characteristic vibrations of chemical bonds. Spectral data

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were collected within the range of 4000–400 cm^{-1}, providing detailed insights into the chemical structure of the samples.

2.2.6. Quantification of Total Polyphenol content (TPC) and Flavonoid content (TFC)

The quantification of polyphenol and flavonoid contents in the extracts was performed using standard colorimetric methods. Polyphenols were measured using the Folin-Ciocalteu reagent, which reacts with phenolic compounds to form a blue complex, and its absorbance was recorded at 765 nm, and the results were expressed as gallic acid equivalents (mg GAE/100 g dry weight) [12]. Similarly, flavonoids were quantified by reacting with aluminum chloride ($AlCl_3$) to form a yellow complex, with absorbance measured at 550 nm, and expressed as catechin equivalents (mg CAE/100 g dry weight) [11].

2.3. Evaluation of Antioxidant Activity

2.3.1. DPPH Radical Scavenging Assay

The DPPH radical scavenging assay was employed to evaluate the antioxidant activity of the extracts. The principle of this method relies on the color change of the DPPH solution from purple to yellow upon reaction with antioxidants, indicating the neutralization of free radicals. Absorbance measurements were recorded at the peak wavelength, and IC_{50} values (the concentration required to inhibit 50% of DPPH radicals) were calculated. Lower IC_{50} values signify stronger antioxidant activity, providing a quantitative measure of the extracts' free radical scavenging capacity. Gallic acid was used as a positive control at four concentrations of 1.0, 2.5, 5.0, and 10.0 μM, had the IC_{50} of 4.66 μM.

2.3.2. Ferric Reducing Antioxidant Power (FRAP)

The ferric reducing antioxidant power (FRAP) assay was used to assess the reducing ability of the extracts. The principle of the method involves the reduction of Fe^{3+} to Fe^{2+} by antioxidants in the sample, resulting in the formation of a blue complex. The absorbance of this complex was measured at 700 nm. EC_{50} values (the concentration required to achieve 50% of the absorbance) were calculated, with lower EC_{50} values indicating stronger reducing capacity and, consequently, higher antioxidant potential. Ascorbic acid was employed as the positive control, exhibiting an EC_{50} of 13.15 μg/mL in the FRAP assay.

2.4. Data Analysis

Data analysis was conducted using Microsoft Excel Office 365 to calculate means and standard deviations for the measured parameters. Statistical analyses, including analysis of variance (ANOVA) and least significant difference (LSD) tests, were performed using Statgraphics Centurion XV to determine the significance of differences between samples. These methods ensured the accuracy and reliability of the results. All measurements were performed in triplicate, and results are expressed as mean ± standard deviation.

3. Results and Discussion

3.1. Evaluation of Basic Chemical Characteristics

3.1.1. Moisture and Glucomannan Contents in Tubers of Amorphophallus Species

Table 1. *Moisture and Glucomannan contents of Fresh Tuber and Tuber Powder.*

No.	Sample Code	Fresh Tuber		Tuber Powder	
		Moisture content (%)	Glucomannan content (%)	Moisture content (%)	Glucomannan content (%)
1	C3-MC1-1	63.25	22.19 ± 1.49^{a}	8.32	60.38 ± 4.06^{a}
2	C3-MC1-2	64.14	27.73 ± 0.77^{b}	7.90	77.32 ± 2.15^{b}
3	C3-MC1-3	63.86	18.13 ± 1.18^{c}	9.09	50.18 ± 3.28^{c}
4	C3-MC2	62.25	-	8.10	-

(-): No glucomannan detected;

Data are presented as mean ± standard deviation (n = 3); Letters ([a], [b], [c]) within the same column indicate statistically significant differences (p < 0.05) in glucomannan content between samples, as determined by the Least Significant Difference (LSD) test.

The moisture content and glucomannan contents of fresh tubers and their corresponding tuber powders of *Amorphophallus sp* was evaluated, as shown in Table 1. The moisture content of fresh tubers ranged from 63.25% to 64.14%, indicating a consistently high water composition across all samples, but was still lower than the water content in *A. konjac* (79.21%) [13]. Upon processing into tuber powder, the moisture content significantly reduced, ranging from 7.90% to 9.09%, which aligns with the expected reduction during drying to enhance storage stability. Among the samples, Tuber 2 exhibited the lowest moisture content in powder form (7.90%), suggesting a slightly better drying efficiency. These results demonstrate the effectiveness of the drying process in achieving low moisture levels, which are crucial for preventing microbial growth and extending the shelf life of the powdered product.

The glucomannan content is a key indicator of the nutritional value and industrial potential of *Amorphophallus* species [14]. As shown in Table 1, the tubers of *Amorphophallus sp* exhibited significantly higher glucomannan levels compared to other species. Among the samples, Tuber 2 (20.5 × 15 × 13 cm) of *Amorphophallus sp* had the highest glucomannan content, with 27.73% in fresh tubers and 77.32% in dry tubers. Tuber 1 (18.5 × 10.5 × 9.5 cm) and Tuber 3 (20.5 × 13 × 10 cm) of *Amorphophallus sp* also contained notable glucomannan levels of 22.19% and 18.13% in fresh tubers, respectively. In contrast, no glucomannan was detected in the tubers of *A. tuberculatus*. When compared with previous studies, the glucomannan content in *Amorphophallus sp* surpasses that of commonly known species such as *A. konjac* (12.26%), *A. krausei* (29.20%), and *A. paeoniifolius* (6.53%) [15], [16].

The results indicated that the larger the tuber size, the greater the glucomannan content. The glucomannan contents of *Amorphophallus sp* tubers were high, promising a good material for supplying glucomannan products in food. The results published the first data on glucomannan content in these two species and provided direction for the agricultural, breeding, and development sectors of *Amorphophallus sp*.

3.1.2. Moisture Content and Extraction Efficiency of Amorphophallus species.

Table 2. *Moisture Content and Extraction Yield of Extracts from Amorphophallus Species*.

No.	Sample Name	Sample Code	Moisture Content (%)	Extraction Yield (%)
1	Leaf extract of *Amorphophallus sp*	C3-TL	13.54	22.14
2	Tuber extract of *Amorphophallus sp*	C3-MC1	23.58	12.99
3	Tuber extract of *A. tuberculatus*	C3-MC2	28.96	13.13

The moisture content and extraction yield are critical parameters affecting the quality and recovery of chemical constituents from *Amorphophallus* species. The data in Table 2 indicate that the leaf extract of *Amorphophallus sp*(C3-TL) had the lowest moisture content (13.54%), significantly lower than the tuber extracts of both *Amorphophallus sp* (C3-MC1: 23.58%) and *A. tuberculatus* (C3-MC2: 28.96%). Regarding extraction efficiency, the leaf extract of *Amorphophallus sp* also exhibited the highest yield (22.14%), surpassing the tuber extracts of *A. tuberculatus* (13.13%) and *Amorphophallus sp* (12.99%). These results highlight that the leaves of *Amorphophallus* spare not only more efficient to extract but also require less energy for moisture removal, making them a cost-effective source of bioactive compounds. Conversely, although the tuber extracts of both species demonstrated lower extraction yields, they are known to contain distinct compounds such as glucomannan, emphasizing their industrial relevance for specific applications [2], [17].

3.2. Qualitative and Quantitative Analysis of Chemical Composition

3.2.1. Preliminary Qualitative Results

The main compound groups identified in extracts from the leaves and tubers of Amorphophallus sp (C3-TL, C3-MC1) and the tubers of Amorphophallus tuberculatus (C3-MC2) included flavonoids, saponins, amino acids, and tannins. The leaf extract of Amorphophallus sp (C3-TL) tested positive for flavonoids, saponins, and amino acids, with a particularly pronounced presence of saponins, a group of compounds commonly found in plant leaves. In contrast, the tuber extracts of both Amorphophallus sp and A. tuberculatus (C3-MC1 and C3-MC2) contained flavonoids, amino acids, and tannins, but no saponins were detected. The preliminary qualitative results provide a foundational dataset on the chemical composition of the studied species, highlighting the prominent presence of biologically significant compounds such as flavonoids, tannins, and amino acids [18].

3.2.2. Qualitative Results Using FTIR Analysis

FTIR spectroscopy of Amorphophallus sp leaf showed the characteristic signals of the following groups of compounds: flavonoids (3383 cm^{-1}stretching vibration of O-H, 1610 cm^{-1}, C=C) and 1066 cm^{-1} (C-O)); saponins (1066 cm^{-1}, C-O-C); alkaloids (3383 and 1403 cm^{-1} N-H, C-N, respectively); amino acids (N-H at 3383 $cm^{-1}$and 1610 cm^{-1}, COO- bond at 1403 cm-1); tannins (3383, 1610, 1066 cm^{-1} align to O-H, C=C, C-OH, respectively); and polysaccharide (glycosidic bonds (C-O, C-C) at 1066 cm^{-1}. Compared to preliminary qualitative analysis, FTIR results show that C3-TL has additional compound groups such as tannin, alkaloid, and polysaccharide (Banoth and Thatikonda 2019).

Similarly, the FTIR of the Amorphophallus sp and A. tuberculatus tuber had specific signals at 3380, 2927, 1610, 1398, 1063, 612 $cm^{-1}$and 3385, 2928, 1620, 1407, 1057, 584 cm^{-1}, respectively. The analysis results of the two tubers were similar to the Amorphophallus sp leaf sample with signals showing the functional groups of the compound groups such as flavonoids, saponins, amino acids, tannins, alkaloids and polysaccharides, among them, saponins, alkaloids, polysaccharides that were not found in the preliminary qualitative results [19].

3.3. Total Polyphenol and Flavonoid Content in Extracts

Table 3. *Total Polyphenol and Total Flavonoid Content of Extracts*.

No	Sample Code	TPC (mg GAE/100 g DW)	TFC (mg CAE/100 g DW)
1	C3-TL	$1,414.4 \pm 9.1^{a}$	$1,564.8 \pm 8.0^{ab}$
2	C3-MC1	921.0 ± 2.9^{b}	$1,462.6 \pm 6.9^{a}$
3	C3-MC2	974.4 ± 1.2^{c}	$1,683.8 \pm 6.4^{b}$

Data are presented as mean ± standard deviation (n = 3); Letters (a,b, c) indicate significant differences ($p < 0.05$) in total polyphenol content among extracts, as determined by the Least Significant Difference (LSD) test.

The total polyphenol content of extracts was determined using the Folin-Ciocalteu method, as shown in Table 3. The leaf extract of *Amorphophallus sp* (C3-TL) exhibited the highest polyphenol content, reaching 1,414.45 ± 9.1 mg GAE/100 g dry weight, significantly surpassing the tuber extracts. In comparison, the tuber extract of *Amorphophallus sp* (C3-MC1) contained 921.0 ± 2.9 mg GAE/100 g DW, while the tuber extract of *A. tuberculatus* (C3-MC2) demonstrated 974.4 ± 1.2 mg GAE/100 g DW. These findings indicate that the leaves of *Amorphophallus sp* are particularly rich in polyphenols, which are renowned for their antioxidant properties. Moreover, among tuber samples, *A. tuberculatus* (C3-MC2) showed a modestly higher polyphenol content than *Amorphophallus sp* (C3-MC1), suggesting interspecies variation in metabolite accumulation. This variation may reflect genetic differences between the species or differing physiological roles of tuber polyphenols.

The total flavonoid content of extracts was quantified using a colorimetric reaction with aluminum chloride ($AlCl_3$), with absorbance measured at 550 nm, as shown in Table 3. Among the extracts, the tuber extract of *Amorphophallus tuberculatus* (C3-MC2) demonstrated the highest flavonoid content at 1,683.8 ± 6.4 CAE/100 g dry weight, followed by the leaf extract of *Amorphophallus sp* (C3-TL) with 1,564.8 ± 8.0 mg CAE/100 g DW, and the tuber extract of *Amorphophallus sp* (C3-MC1) at 1,462.6 ± 6.9 mg CAE/100 g DW. These results highlight the significant presence of flavonoids in both species, particularly in *A. tuberculatus*, suggesting their potential as rich sources of antioxidants. These findings align with earlier studies showcasing the antioxidant potential of flavonoid-rich plant extracts [18]. The higher flavonoid content in *A. tuberculatus* tubers compared to *Amorphophallus sp* tubers further underscores species-specific differences in secondary metabolite profiles. Interestingly, while leaves had the highest polyphenol content, *A. tuberculatus* tubers led in flavonoids, indicating a possible tissue- and species-dependent distribution of bioactives [7], [13], [19].

3.4. Evaluation of Biological Activities

3.4.1. DPPH Radical Scavenging Activity

Table 4. *DPPH Radical Scavenging Ability of Extract Samples.*

Sample	Percentage Inhibition (%)				IC50 (µg/mL)
	10 (µg/mL)	20 (µg/mL)	50 (µg/mL)	100 (µg/mL)	
C3-TL	2,86 ± 0,84a	6,91 ± 0,70b	18,96 ± 0,85c	45,20 ± 0,86d	>100
C3-MC1	3,15 ± 0,97a	5,06 ± 0,57a	9,32 ± 1,67b	16,05 ± 1,10c	
C3-MC2	4,14 ± 0,36a	6,30 ± 0,45b	10,13 ± 0,44c	19,21 ± 0,65d	

Data are presented as mean ± standard deviation (n = 3). Letters (a, b, c, d) within the same row indicate significant differences ($p < 0.05$) in the percentage inhibition of DPPH, as determined by the Least Significant Difference (LSD) test.

The DPPH radical scavenging assay was used to evaluate the antioxidant activity of the extracts from Amorphophallus species, as presented in Table 4. Among the samples, the leaf extract of Amorphophallus sp (C3-TL) exhibited the highest scavenging ability with an IC_{50} value of 45.20 ± 0.86 µg/mL, indicating weak antioxidant activity. This activity correlated with its higher polyphenol and flavonoid content, which are well-established contributors to radical scavenging properties. In comparison, the tuber extracts of Amorphophallus sp (C3-MC1) and A. tuberculatus (C3-MC2) demonstrated lower activity, with IC_{50} values exceeding 100 µg/mL, highlighting their comparatively reduced efficacy in neutralizing free radicals. It was suggested that the leaf extract's DPPH free radical inhibitory activity was more potent than the tuber extract's, and both were weak.

3.4.2. Ferric Reducing Antioxidant Power (FRAP)

Table 5. *Ferric Reducing Antioxidant Power (FRAP) of ascorbic acid and Extract Samples.*

Concentration (mg/mL)	Absorbance			
	Ascorbic acid	C3-TL	C3-MC1	C3-MC2
0,10	0,567 ± 0,020^{a}	± 0,003^{a}	0,016 ± 0,001^{a}	0,015 ± 0,001^{a}
0,25	1,520 ± 0,043^{b}	0,076 ± 0,005^{b}	0,039 ± 0,002^{b}	0,036 ± 0,003^{b}
0,50	2,067 ± 0,092^{c}	0,156 ± 0,009^{c}	0,074 ± 0,004^{c}	0,083 ± 0,009^{c}
1,00	2,074 ± 0,015^{c}	0,307 ± 0,005^{d}	0,153 ± 0,002^{d}	0,169 ± 0,006^{d}
EC_{50} (mg/mL)	< 0,1	>1,0	>1,0	>1,0

Data are presented as mean ± standard deviation (n=3). Letters a,b,c,d indicate significant differences ($p < 0.05$) in absorbance among samples at the same concentration, as determined by the Least Significant Difference (LSD) test.

The Ferric Reducing Antioxidant Power (FRAP) assay, shown in Table 5, evaluated the ability of the extracts to reduce Fe^{3+} to Fe^{2+}, which reflects their antioxidant potential. Ascorbic acid, used as a positive control, demonstrated the highest reducing power, with an EC_{50} value below 0.1 mg/mL. Among the extracts, the leaf extract of Amorphophallus sp (C3-TL) showed the strongest reducing ability, as evidenced by its absorbance values, particularly at the highest concentration of 1.00 mg/mL (0.307 ± 0.005). However, its EC_{50} value exceeded 1.0 mg/mL, indicating moderate reducing power compared to ascorbic acid. The tuber extracts of Amorphophallus sp (C3-MC1) and A. tuberculatus (C3-MC2) exhibited weaker reducing capacities, with absorbance values significantly lower than those of the leaf extract at all tested concentrations.

These findings suggest that the leaf extract of Amorphophallus sp has a higher antioxidant potential, likely due to its richer composition of bioactive compounds, making it a promising candidate for further development in antioxidant applications. The antioxidant potential of Amorphophallus extracts, as assessed by DPPH and FRAP assays, revealed clear differences among plant parts and species. The leaf extract of Amorphophallus sp (C3-TL) consistently demonstrated the strongest antioxidant capacity across both assays, likely due to its significantly higher polyphenol and flavonoid content. In the DPPH assay, this sample exhibited the lowest IC_{50} value (45.20 ± 0.86 µg/mL), reflecting moderate radical scavenging activity. In contrast, both tuber extracts—Amorphophallus sp (C3-MC1) and A. tuberculatus (C3-MC2)—showed lower activity with IC_{50} values exceeding 100 µg/mL, indicating relatively weak scavenging effects. Similarly, the FRAP assay confirmed this trend, where C3-TL again showed superior ferric-reducing power, although its EC_{50} remained >1.0 mg/mL—far less potent than the positive control, ascorbic acid (EC_{50} < 0.1 mg/mL) [18], [19].

These findings underscore both tissue- and species-specific variation in antioxidant properties, where leaves of Amorphophallus sp contain a more diverse and abundant profile of antioxidant compounds than tubers. Interestingly, while A. tuberculatus (C3-MC2) showed a higher flavonoid content than Amorphophallus sp (C3-MC1), it did not translate into superior antioxidant activity in either assay, suggesting that compound composition, structure, and synergistic interactions—not just quantity—play crucial roles in antioxidant efficacy. These results are in agreement with previous studies showing that leaf extracts from various Amorphophallus species tend to exhibit greater antioxidant activity than tubers, owing to their richer accumulation of bioactive secondary metabolites such as flavonoids, tannins, and phenolic acids [18]. Similar observations were made in other plant systems where leaf tissues consistently outperformed roots or tubers in antioxidant assays due to their exposure to oxidative stress in the aerial environment, promoting enhanced secondary metabolite synthesis [19].

4. Conclusions

This study provides a comprehensive understanding of the chemical composition and biological activities of two *Amorphophallus* species: *Amorphophallus sp* and *Amorphophallus* tuberculatus. The tubers of Amorphophallus sp exhibited high glucomannan content (22.19%–27.73% in fresh tubers), while no glucomannan was detected in *A. tuberculatus*. The larger the tuber size, the greater the glucomannan content in *Amorphophallus sp* tubes. Chemical analysis identified flavonoids, polyphenols, tannins, and amino acids in the leaves of *Amorphophallus sp*. The leaf extract of *Amorphophallus sp* showed the most potent antioxidant activity, with the highest inhibition percent at an extract concentration of 100 µg/mL (DPPH: 45.20 %) and the optical density of 0.034, while the tuber extracts of both species demonstrated too weak activity. These findings highlight the potential of *Amorphophallus* species as valuable resources for functional food owing to high glucomannan content and non-antioxidative activity, suggesting other bioactivities, such as antiglucosidase inhibition, in the following study.

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Conflict of Interest

The authors declare no conflict of interest.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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