

ANTICANCER ACTIVITY TEST OF BAMBOO GRASS (*LOPHATHERUM GRACILE B.*) EXTRACT USING ULTRASONIC METHOD AGAINST T47D BREAST CANCER CELLS

Qurrotul A'yun¹, Iqlila Romaidha², Mawaqit Makani³, Sarinah⁴
^{1,3,4}Program Studi Sarjana Farmasi, STIKES Borneo Cendekia Medika
²Program Studi D3 Analisis Kesehatan, STIKES Borneo Cendekia Medika
Corresponding Author: aayun.qurrotaa@gmail.com

ABSTRACT

Bamboo grass (*Lophatherum gracile B.*) is a weed species with potential medicinal value due to its content of various secondary metabolites. However, scientific information regarding its anticancer activity remains limited. This study aimed to evaluate the anticancer activity of bamboo grass extracts against human breast cancer cells (T47D) obtained through ultrasonic extraction. Extraction was performed using three different solvents, namely 80% ethanol, *n*-hexane, and chloroform. All extracts were tested for their anticancer activity using the MTT assay to determine IC₅₀ values. Furthermore, tannin compounds from the 80% ethanol extract were separated using thin-layer chromatography (TLC) and characterized by Fourier Transform Infrared Spectroscopy (FTIR). The results demonstrated that the 80% ethanol extract exhibited the strongest anticancer activity with an IC₅₀ value of 218.081 µg/mL, compared with *n*-hexane (292.412 µg/mL) and chloroform extracts (395.144 µg/mL). FTIR analysis of the tannin fraction revealed characteristic absorption peaks corresponding to functional groups of tannins, including O–H stretching of alcohol (3455 cm⁻¹), C–O stretching of secondary alcohol (1094 cm⁻¹), aliphatic C–H stretching (2963 and 2929 cm⁻¹), C=C stretching of alkenes (1650 cm⁻¹), and ortho-substituted aromatic rings (780 cm⁻¹). Bamboo grass shows promising potential as a natural source of anticancer compounds, particularly through its 80% ethanol extract containing tannins with bioactive properties.

Keywords: *Lophatherum gracile B.*, T47D breast cancer cells, ultrasonic method, MTT assay, tannin

ABSTRAK

Tanaman rumput bambu (*Lophatherum gracile B.*) merupakan gulma yang memiliki potensi sebagai tanaman obat karena mengandung berbagai metabolit sekunder. Namun, informasi mengenai aktivitas antikanker dari tanaman ini masih terbatas. Penelitian ini bertujuan untuk mengevaluasi aktivitas antikanker terhadap sel kanker payudara T47D dari ekstrak bamboo grass yang diperoleh melalui metode ekstraksi ultrasonik. Ekstraksi dilakukan dengan tiga jenis pelarut, yaitu etanol 80%, *n*-heksana, dan kloroform. Seluruh ekstrak kemudian diuji aktivitas antikanker menggunakan metode MTT assay untuk menentukan nilai IC₅₀. Selanjutnya, senyawa tanin dari ekstrak etanol 80% dipisahkan dengan kromatografi lapis tipis (KLT) dan diidentifikasi menggunakan Fourier Transform Infrared Spectroscopy (FTIR). Hasil penelitian menunjukkan bahwa ekstrak etanol 80% memiliki aktivitas paling tinggi dengan nilai IC₅₀ sebesar 218,081 µg/mL, dibandingkan ekstrak *n*-heksana (292,412 µg/mL) dan kloroform (395,144 µg/mL). Identifikasi FTIR pada fraksi tanin dari

ekstrak etanol menunjukkan adanya puncak serapan khas, yaitu gugus O–H alkohol (3455 cm^{-1}), C–O alkohol sekunder (1094 cm^{-1}), C–H alifatik (2963 dan 2929 cm^{-1}), ikatan rangkap C=C alkena (1650 cm^{-1}), serta cincin aromatik orto-tersubstitusi (780 cm^{-1}). Dengan demikian, ekstrak etanol bamboo grass berpotensi sebagai sumber senyawa antikanker alami, khususnya melalui kandungan tanin.

Kata Kunci: *Lophatherum gracile* B., sel kanker payudara T47D, metode ultrasonic, metode MTT, tanin

Introduction

Cancer is a disease characterized by uncontrolled cell proliferation, originating from cells that have undergone genetic transformation (Brown et al., 2023). One of the treatment methods used to destroy cancer cells is chemotherapy. However, chemotherapy still has side effects that can impact normal, healthy cells (Anand et al., 2023). The use of natural substances as active anticancer agents can help minimize these side effects (Asma et al., 2022). One natural substance that is still rarely utilized for its anticancer properties is bamboo grass (*Lophatherum gracile* Brongn).

Lophatherum gracile Brongn is one of three types of weed plants with strong potential as an herbal remedy for certain diseases, such as inflammation (Lai et al., 2021). In addition, studies have shown that ethanol extract of *Lophatherum gracile* Brongn has the potential to inhibit SARS-CoV-2 pseudovirus infection (Chen et al., 2023), prevent osteoporosis by inhibiting MAPKs and NFkB activity (Lee et al., 2022), and act as an anti-fatigue agent by increasing LDH activity, reducing BLSA levels, and decreasing protein catabolism (Deng et al., 2021).

The potential of bamboo grass as a breast cancer treatment has begun to be investigated by Istiqomah et al. (Istiqomah et al., 2015). The results showed that the IC_{50} values of T47D breast cancer cell inhibition using maceration extracts of bamboo grass leaves were $300.7\text{ }\mu\text{g/mL}$ for the *n*-hexane fraction, $321.4\text{ }\mu\text{g/mL}$ for 80% ethanol extract, $177.8\text{ }\mu\text{g/mL}$ for the chloroform fraction, and $428.580\text{ }\mu\text{g/mL}$ for hydrolyzed extracts. Additionally, Firdaus (2016) found that the IC_{50} value of isolated tannin from bamboo grass extract against T47D breast cancer cells was $2.046\text{ }\mu\text{g/mL}$ (I. A. Firdaus, 2016). Other studies have demonstrated that bamboo grass extract exhibits anticancer activity by inhibiting colony formation, migration, and invasion of HT1080 cancer cells, as well as suppressing MMP expression and HIF-1 α accumulation through the Akt/mTOR/p70S6K signaling pathway (Kim et al., 2016). These findings indicate that one of the active compounds found in bamboo grass is tannin. Tannin is a secondary metabolite compound that has potential as an anticancer agent against T47D breast cancer cells.

T47D is a breast cancer cell line derived from the ductal epithelium of a 54-

year-old female patient with advanced-stage breast cancer (Firmansyah et al., 2024). Cancer is a multifactorial disease influenced by genetic, environmental, and lifestyle factors. One important mechanism involves the imbalance between free radicals and antioxidants, leading to cellular damage and uncontrolled proliferation (Arsianti et al., 2022). Conventional therapies such as radiation and chemotherapy often weaken the immune system, thus increasing interest in natural plant-derived compounds as alternative therapies (Ghasemi et al., 2021; Yusuf et al., 2023). The cytotoxic effects of these natural compounds on cancer cells can be evaluated using the MTT assay, which offers a fast, simple, and accurate method (Azzoz et al., 2024).

The secondary metabolite compounds contained in bamboo grass plants are diverse. Ethanol extract from bamboo grass leaves has been shown to contain terpenoids, tannins, and alkaloids (Sari, 2014). 80% ethanol and hydrolyzed ethanol extracts of bamboo grass leaves contain alkaloids, tannins, and triterpenoids, whereas chloroform and *n*-hexane extracts contain steroids and tannins (Auwaliyah, 2015). Recent studies have also indicated that the stems and leaves

of *Lophatherum gracile* Brongn contain flavonoids, phenolic acids, triterpenoids, polysaccharides, and other compounds. (Liu et al., 2022; Yao et al., 2025; Zhang et al., 2021)

The effort to obtain tannin compounds from bamboo grass is carried out through extraction processes. Several studies have demonstrated that ultrasonic extraction yields better activity test results compared to maceration. Research by Debiassi et al., showed that the EC₅₀ value of antioxidant activity in white bracts with spring flowers (*Bougainvillea spectabilis* Willd.) was 2.53 after 7 days of maceration, while ultrasonic extraction for 240 minutes yielded a value of 2.30 (Debiassi et al., 2021).

In addition, the IC₅₀ values of coffee bean extracts for antioxidant activity using the maceration method in Arabica, Robusta, and Liberica were 70.44; 63.54; and 69.64 ppm, respectively. In contrast, ultrasonic extraction yielded IC₅₀ values of 46.66; 49.42; and 45.37 ppm. Based on these findings, ultrasonic extraction produced relatively better IC₅₀ values compared to the maceration method. Moreover, the extraction time required was significantly shorter (S. M. Firdaus et al., 2025).

Materials and Methods

The ultrasonic extraction process of bamboo grass (*Lophatherum gracile*) powder was carried out using different solvents: 80% ethanol, chloroform, and *n*-hexane. The concentrated extracts were subjected to secondary metabolite screening using appropriate reagents. All extracts were tested for anticancer activity against T47D breast cancer cells using the Microculture Tetrazolium Salt (MTT) assay in vitro. Doxorubicin was used as the positive control in the anticancer activity test. The extract with the best anticancer activity was further subjected to tannin compound separation using Preparative Thin Layer Chromatography (PTLC), and the isolated tannin was identified using Fourier Transform Infrared Spectroscopy (FTIR).

Result and Discussion

Extraction of Bamboo Grass Plant

Extraction of active compounds from bamboo grass plants using ultrasonic techniques. The principle of ultrasonic extraction is based on the enhancement of the extraction process caused by cavitation bubbles generated by ultrasonic waves. A total of 10 grams of bamboo grass powder is extracted in 100 mL of solvent. Ultrasonic extraction is carried out for 20 minutes at room temperature with a frequency of 20 kHz. The obtained filtrate is concentrated using a rotary vacuum evaporator. The yield of ultrasonic extraction from the bamboo grass plant is shown in Table 1.

Table 1. Results of ultrasonic extraction of bamboo grass plants

Solvent	extract weight (g)	yield(%) (b/b)
80% ethanol (-0,24)	0,38	3,8%
chloroform (2.00)	0,42	4,2%
<i>n</i> -hexane (3.50)	0,14	1,4%

The yield produced from each solvent varies. The chloroform solvent has the highest yield at 4.2%, while the *n*-hexane solvent has the lowest yield at 1.4%. One of the factors influencing yield is the polarity of the solvent. The partition coefficient (log P) values of ethanol, chloroform, and *n*-hexane are -0.24, 2.00, and 3.50, respectively. Chloroform has semi-polar properties, indicating that most of the compounds found in bamboo grass have a polarity similar to that of chloroform, allowing it to extract more components compared to other solvents.

Additionally, the extraction time can affect the differences in yield and the types of components extracted with each solvent. If the extraction time is too short, the bioactive components extracted from the material may not be maximized. Another factor influencing the amount and type of components extracted is frequency. The ultrasonic capability to produce cavitation bubbles depends on the ultrasonic frequency. An increase in frequency reduces the minimum pressure, requiring more energy for cavitation

formation in the system, which leads to decreased production of cavitation bubbles. This affects the diffusion process and results in inadequate extraction of the compounds (Bucur et al., 2023).

Research on the same plant has also been conducted using the maceration extraction method. In that study, 200 grams of bamboo grass were extracted with 800 mL of 80% ethanol solvent for 24 hours, yielding a result of 10.79% (Wulandari, 2017). In contrast, this study achieved a yield of 3.4% from a 10-gram sample in 100 mL of 80% ethanol over 20 minutes.

Comparing the results of both studies in terms of sample amount, solvent volume, and extraction duration, the ultrasonic extraction method appears to provide better results than maceration extraction. The ultrasonic extraction method offers higher efficiency compared to maceration, using fewer samples and solvents, allowing for faster diffusion rates and shorter extraction times.

Phytochemical Test of Bamboo Grass Extract with Reagents

The phytochemical test is conducted to determine the chemical compound content within the bamboo grass plant. A number of suitable reagents were added to each crude extract of the bamboo grass plant. The results of the identification of the active compound groups found in the bamboo grass plant extract are shown in **Table 2**.

Based on the observations from the phytochemical test listed in **Table 2**, it was found that the ethanol and chloroform extracts contained tannins, flavonoids, triterpenoids, and steroids. The *n*-hexane solvent contained the least amount of compounds compared to the 80% ethanol extract and the chloroform extract. This is consistent with the yield results shown in Table 1, where the *n*-hexane extract had the lowest yield, amounting to 1.4%. Factors affecting the types of compounds extracted include the type of solvent, extraction time, and frequency of extraction.

Table 2. The results of the test on the active compound content of 80% ethanol extract, chloroform, and *n*-hexane of bamboo grass plants

Active compounds	Ethanol 80%	Chloroform	<i>n</i> -Hexane
Alkaloid			
(Mayer)	-	-	-
(Dragendorf)	-	-	-
Flavonoid	+	+	-
Tannin	+	+	-
Saponin	-	-	-
Triterpenoid	+	+	-
Steroid	+	+	+

Description: + = contains compound; - = does not contain compound

T47D Breast Anticancer Activity Test

The anti-cancer testing was conducted with variations in concentration, namely 1000; 500; 250; 125; 62.5; 31.25; and 15.625 $\mu\text{g/mL}$. The anti-cancer activity test was performed in vitro using the MTT method. The results of the extract testing on cancer cells (treatment) can be observed after the addition of MTT reagent. At the stage of adding the MTT reagent, a colorimetric reaction will occur. The MTT reagent is absorbed by living cells and is broken down by the enzyme succinate dehydrogenase in the mitochondrial respiratory chain into formazan. Thus, the MTT reagent will undergo a color change from yellow to blue-purple (formazan crystals), while dead cells will remain yellow.

Observation of the cells after treatment was conducted under an inverted microscope. The morphology of T47D breast cancer cells before and after treatment is shown in **Figure 1**. Breast cancer cells before and after treatment can be clearly observed (**Fig.1**).

The cancer cells before treatment are oval-shaped, have volume, and adhere to the bottom of the cell culture dish, while the dead cells (after treatment) are needle-like, with decreased volume and size. Furthermore, the cancer cells resulting from the treatment are treated with MTT reagent. The living cancer cells are able to absorb MTT and undergo a color change to purple. The intensity of the resulting color is measured for absorbance using an

ELISA reader. The absorbance value obtained is related to the percentage of live cells; a higher absorbance indicates a greater number of live cells.

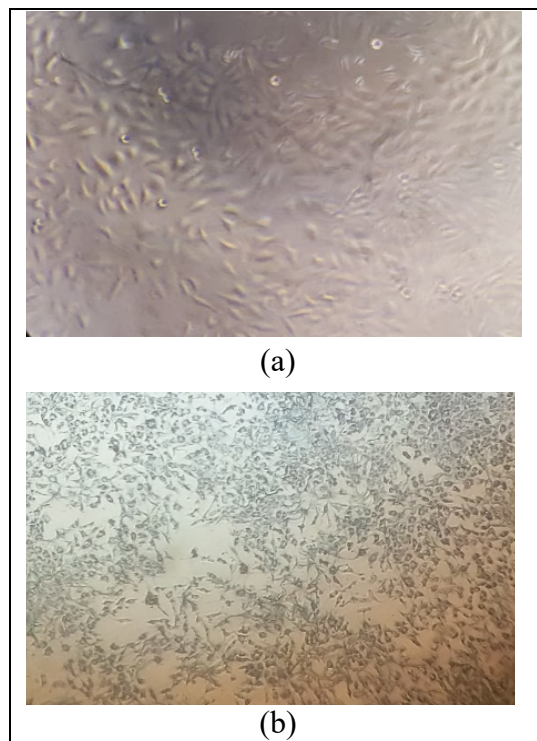


Figure 1. Observations of T47D breast cancer cells under an inverted microscope: (a) Cancer cells before treatment (b) Cancer cells after treatment.

The percentage of live cells decreases as the sample concentration increases. Higher sample concentrations are more effective at killing cancer cells compared to lower concentrations. Upon observing the overall percentage of live cells from each extract, some results do not correspond as expected. This discrepancy may be due to contamination, such as the introduction of unwanted substances into the wells or samples,

which affects the cancer cell activity test. The IC_{50} results for each sample are shown in **Table 3**.

Table 3. Results of the IC_{50} anticancer activity test

Sample	IC_{50} ($\mu\text{g/mL}$)
Ethanol extract 80%	218,08
Chloroform extract	292,41
<i>n</i> -hexane extract	395,14
Doxorubicin	1,54

The IC_{50} value is the concentration that can inhibit cell growth by 50% (Garcia-Molina et al., 2022). The anticancer activity of the extract could be classified into 4 groups according to the IC_{50} value, namely $IC_{50} \leq 20 \mu\text{g/mL}$ was classified as active, IC_{50} : 20-100 $\mu\text{g/mL}$ was classified as quite active, IC_{50} : 100–1000 $\mu\text{g/mL}$ was classified as weakly active, and $IC_{50} > 1000 \mu\text{g/mL}$ was classified as inactive (Fithrotunnisa et al., 2020).

The IC_{50} values of the 80% ethanol extract, chloroform extract, and *n*-hexane extract were 218.081, 292.412, and 395.144 $\mu\text{g/mL}$, respectively. These results indicate weak activity against T47D breast cancer cells. This finding is consistent with Istiqomah (2015) (Istiqomah et al., 2015), who also reported weak inhibition of T47D cells. However, compared to the study of Firdaus (2016) (I. A. Firdaus, 2016), pure tannin compounds isolated from bamboo grass extract exhibited very strong inhibitory activity against T47D breast cancer cells,

with an IC_{50} value of 2.046 $\mu\text{g/mL}$. According to Rajčević et al. (2022), the abundance and diversity of compounds in an extract may lead to synergistic, antagonistic, or other interactions among metabolites, ultimately influencing the level of cytotoxicity. Synergistic effects between primary and secondary metabolites may enhance anticancer activity, while antagonistic effects may reduce it.

Among the three extracts, the *n*-hexane extract exhibited the weakest activity against T47D cells, likely due to the presence of only one secondary metabolite, which resulted in very low activity. In a previous study, A'ilah (A'ilah, 2015) reported that fractionation of bamboo grass roots with *n*-hexane showed considerable cytotoxic activity against T47D breast cancer cells, with an IC_{50} value of 65.461 $\mu\text{g/mL}$. Furthermore, Rohmah (Rohmah, 2016) demonstrated that the *n*-hexane extract of bamboo grass roots had even stronger cytotoxic activity, with an IC_{50} of 49.52 $\mu\text{g/mL}$. This higher activity was attributed to the greater diversity of secondary metabolites in the root extract, including alkaloids, saponins, tannins, and terpenoids. Moreover, the anticancer activity of the bamboo grass root extract against T47D cells significantly increased, reaching an IC_{50} of 2.192 $\mu\text{g/mL}$ when combined with a



drug delivery system utilizing NaX zeolite (Rohmah, 2016).

In comparison, the IC_{50} value of doxorubicin was 1.544 $\mu\text{g/mL}$, which is markedly lower than those of the three plant extracts. This difference is likely due to the crude nature of the plant extracts, which may contain a variety of compounds that interfere with anticancer activity, thereby slowing the inhibition of cancer cell proliferation.

Based on these findings, further research is required, for instance through fractionation extraction processes, testing on early-stage breast cancer cells, or the incorporation of drug delivery systems to maximize anticancer activity.

Separation of Tannin Compounds use Thin Layer Chromatography

Tannin compounds obtained from 80% ethanol extraction using the eluent *n*-butanol: acetic acid: water (BAA) in a ratio of 4:1:5. The spots resulting from the separation were detected by spraying FeCl_3 reagent on the surface of the plate and then examined under UV light at wavelengths of 254 and 366 nm. The separation results of the tannin compound group from the 80% ethanol extract yielded 3 spots with different R_f values.

The calculated R_f values are listed in **Table 4**.

The spots assumed to be tannin compounds are spots 1 and 2, which have R_f values of 0.62 and 0.7, respectively. Umarudin et al. also mentioned that the tannin compounds contained in celery plants produce a violet color under UV light at 366 nm. The differences in R_f values obtained from these two spots indicate that there are two types of tannins with different polarity properties.

The tannin at R_f 0.7 is more polar as it tends to interact with the moving phase of the BAA eluent (4:1:5), while the tannin at R_f 0.62 tends to interact more with the stationary phase of the silica plate. Additionally, spot 3 shows a light green color under UV light at 366 nm. This spot is suspected to be a flavonoid compound, supported by Pradana's research, which found that separation conducted on binahong tuber extract using BAA (4:1:5) eluent contained flavonoid compounds that produced green spots under UV light at 366 nm. Based on these research results, it is suspected that the groups of tannin compounds are spots 1 and 2, which exhibit a purple color under UV light at 366 nm.

Table 4. Results of the Separation of Tannin Compounds from Bamboo Grass Plant Extract using 80% Ethanol

R_f value	Color of stains under UV light 254 nm		Color of stains under UV light 366 nm		Suspected compound
	Before spraying	After spraying	Before spraying	After spraying	
	$FeCl_3$	$FeCl_3$	$FeCl_3$	$FeCl_3$	
0,62	Black	Purple	Purple	Faded purple	Tannin
0,7	Faded black	Purple	Purple	Faded purple	Tannin
0,78	-	-	Green	-	Flavonoid

Description: R_f : distance traveled

Identification of Tannin Isolate using FTIR

The isolates from TLC suspected to be tannin compounds were identified using an FTIR spectrophotometer. The FTIR spectrum results shown in **Figure 2** indicate several important absorptions. At the wave number 3455 cm^{-1} , there is a strong absorption band for O-H alcohol groups due to intramolecular hydrogen bond vibrations. The presence of alcohol is also supported by the secondary alcohol C-O absorption band at 1094 cm^{-1} . Furthermore, wave numbers 2963 and 2929 cm^{-1} show aliphatic C-H stretching absorptions. At wave numbers 1650 and 1559 cm^{-1} , C=C absorptions in aromatic ring chains are observed. The suspicion of tannin compounds is reinforced by the

absorption of the substituted aromatic ring at the ortho position in the fingerprint region at the wave number 780 cm^{-1} .

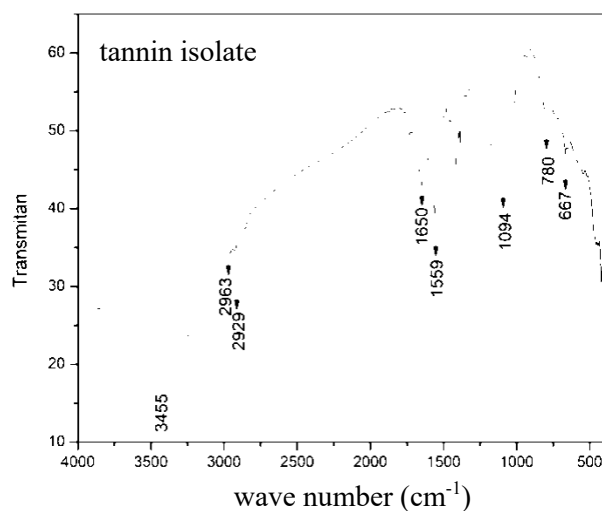


Figure 2. IR Spectrum of the tannin isolate from 80% ethanol extract

Table 5. IR Spectrum of the suspected tannin isolate from 80% ethanol extract

No.	Wave number (cm ⁻¹)		intensity	Vibration
	Isolate spectra	literature spectrum (Silverstein, 2005) [21]		
1.	3455	3550-3200	strong	O-H stretching
2.	2963	2940-2860	medium	C-H aliphatic aromatic stretching
3.	2929	2940-2860	medium	C-H aliphatic aromatic stretching
4.	1650	2000-1550	weak	C=C aromatic ring stretch
5.	1559	2000-1550	medium	C=C aromatic ring stretch
6.	1094	1125-1085	medium	C-O stretching of secondary alcohols
7.	780	800-600	weak	Ortho-substituted aromatic ring
8.	667; 544	600~	weak	Aromatic constituent substituents

Conclusion

1. The ultrasonic extraction results over 20 minutes yielded a relatively low rendement, indicating that optimization of the extraction process is needed.
2. The three extracts from bamboo grass, namely 80% ethanol, *n*-hexane, and chloroform, have IC₅₀ values of 218.081; 292.412; and 395.144 µg/mL, respectively. All three extracts exhibited weak potential in inhibiting and killing T47D breast cancer cells.
3. The results of the anticancer activity test for the ultrasonic extract were better compared to those obtained through maceration.
4. The identification of tannin compounds using FTIR instrumentation showed the presence of absorptions corresponding to O-H alcohol groups, secondary C-O alcohols, aliphatic C-H, C=C alkenes with wave numbers of 3455; 1094; 2963; 2929; and 1650 cm⁻¹. Additionally, the absorption of the aromatic ring substituted at the ortho position appeared at a wave number of 780 cm⁻¹.

References

- A'ilah, A. F. (2015). *Uji aktivitas antikanker terhadap sel kanker payudara T47D dan identifikasi golongan senyawa aktif dari ekstrak dan Fraksi Akar Rumpun Bambu (Lophatherum Gracile B.)*. <http://etheses.uin-malang.ac.id/49551/>
- Anand, U., Dey, A., Chandel, A. K. S., Sanyal, R., Mishra, A., Pandey, D. K., De Falco, V., Upadhyay, A., Kandimalla, R., Chaudhary, A., Dhanjal, J. K., Dewanjee, S., Vallamkondu, J., & Pérez de la Lastra, J. M. (2023). Cancer chemotherapy and beyond: Current status, drug candidates, associated risks and progress in targeted therapeutics. *Genes & Diseases*, *10*(4), 1367–1401. <https://doi.org/10.1016/j.gendis.2022.02.007>
- Arsianti, A., Pasha Mahindra, S., Nur Azizah, N., Megawati Fajrin, A., & Dameria Nadapdap, L. (2022). Phytochemical Analysis, Antioxidant and Anticancer Effects of Clitoria ternatae Extract on Breast T47D Cancer Cells. *Indonesian Journal of Medical Chemistry and Bioinformatics*, *1*(1). <https://doi.org/10.7454/ijmcb.v1i1.1003>
- Asma, S. T., Acaroz, U., Imre, K., Morar, A., Shah, S. R. A., Hussain, S. Z., Arslan-Acaroz, D., Demirbas, H., Hajrulail-Musliu, Z., Istanbulugil, F. R., Soleimanzadeh, A., Morozov, D., Zhu, K., Herman, V., Ayad, A., Athanassiou, C., & Ince, S. (2022). Natural Products/Bioactive Compounds as a Source of Anticancer Drugs. *Cancers*, *14*(24), 6203. <https://doi.org/10.3390/cancers14246203>
- Auwaliyah, F. (2015). *Antioxidant activity test of bamboo grass leaf extract (Lophatherum gracile Brongn) using DPPH method and identification of its active compounds*. Maulana Malik Ibrahim State Islamic Univ. of Malang.
- azzoz, mohamed, zaghloul, mostafa, sayed, M., soliman, heba, mounir, N., abdel shakour, N., El-Dabae, W., &

- aly, saleh. (2024). Efficiency of MTT and Trypan Blue Assays for Detection of Viability and Recovery of Different Frozen Cell Lines. *Egyptian Journal of Veterinary Sciences*, 55(6), 1649–1657.
<https://doi.org/10.21608/ejvs.2024.260687.1764>
- Brown, J. S., Amend, S. R., Austin, R. H., Gatenby, R. A., Hammarlund, E. U., & Pienta, K. J. (2023). Updating the Definition of Cancer. *Molecular Cancer Research*, 21(11), 1142–1147.
<https://doi.org/10.1158/1541-7786.MCR-23-0411>
- Bucur, M.-P., Radulescu, M.-C., Radu, G. L., & Bucur, B. (2023). Cavitation-Effect-Based Treatments and Extractions for Superior Fruit and Milk Valorisation. *Molecules*, 28(12), 4677.
<https://doi.org/10.3390/molecules28124677>
- Chen, Y.-L., Chen, C.-Y., Lai, K.-H., Chang, Y.-C., & Hwang, T.-L. (2023). Anti-inflammatory and antiviral activities of flavone C-glycosides of *Lophatherum gracile* for COVID-19. *Journal of Functional Foods*, 101, 105407.
<https://doi.org/10.1016/j.jff.2023.105407>
- Debiasi, B. W., Rodrigues, P. G. R. S., Torres, M. P. R., Bonacorsi, C., Andrighetti, C. R., Ribeiro, E. B., & Valladão, D. M. S. (2021). Comparison between maceration and ultrasound-assisted extraction of white bracts with flowers of *Bougainvillea spectabilis* Willd. *Scientific Electronic Archives*, 14(2), 47.
<https://doi.org/10.36560/14220211297>
- Deng, Y., Huang, D., & Yue, T. (2021). Purification Technology of Polysaccharides from *Lophatherum gracile* Brongn. by Macroporous Resin Adsorption and Its Effect on Athletic Endurance of Mice. *Science and Technology of Food Industry*, 42(14), 169–174.
<https://doi.org/10.13386/j.issn1002-0306.2020090194>
- Firdaus, I. A. (2016). *Identifikasi tanin pada fraksi air tanaman rumput bambu (Lophatherum gracile B.) dan uji aktivitas antikanker isolat tanin terhadap sel kanker payudara T47D*. Maulana Malik Ibrahim State Islamic University of Malang.
- Firdaus, S. M., Permadi, A., & Sulistiawati, E. (2025). Comparative study of ultrasonic and maceration extraction in enhancing antioxidant and SPF properties of green coffee beans serum. *Current Research on Biosciences and Biotechnology*, 6(2), 2025–2061.
<https://doi.org/10.5614/crb.2025.6.2/GAMCE9IN>
- Firmansyah, T., Utami Sara, Ilham Kurniadi, Jannatan Robby, & Maliza Rita. (2024). Cytotoxic Effects of Plant Bioactive Compounds on T47d Breast Cancer Cells Line: A Review. *Bioeksperimen*, 10, 11–22.
- Fithrotunnisa, Q., Arsianti, A., Kurniawan, G., Qorina, F., Tejaputri, N. A., & Azizah, N. N. (2020). In vitro Cytotoxicity of *Hibiscus sabdariffa* Linn Extracts on A549 Lung Cancer Cell Line. *Pharmacognosy Journal*, 12(1), 14–19.
<https://doi.org/10.5530/pj.2020.12.3>
- Garcia-Molina, P., Garcia-Molina, F., Teruel-Puche, J. A., Rodriguez-Lopez,

- J. N., Garcia-Canovas, F., & Muñoz-Muñoz, J. L. (2022). The Relationship between the IC50 Values and the Apparent Inhibition Constant in the Study of Inhibitors of Tyrosinase Diphenolase Activity Helps Confirm the Mechanism of Inhibition. *Molecules*, 27(10), 3141. <https://doi.org/10.3390/molecules27103141>
- Ghasemi, M., Turnbull, T., Sebastian, S., & Kempson, I. (2021). The MTT Assay: Utility, Limitations, Pitfalls, and Interpretation in Bulk and Single-Cell Analysis. *International Journal of Molecular Sciences*, 22(23), 12827. <https://doi.org/10.3390/ijms222312827>
- Istiqomah, A., Muti'ah, R., & Hayati, E. K. (2015). Anticancer Activity against Breast Cancer Cells T47D and Identification of Its Compound from Extracts and Fractions of Leaves Bamboo Grass (*Lophatherum gracile* B.). *ALCHEMY*, 4(1). <https://doi.org/10.18860/al.v4i1.3138>
- Kim, A., Im, M., Gu, M. J., & Ma, J. Y. (2016). Ethanol extract of *Lophatherum gracile* Herba exhibits anti-cancer activity in human cancer cells by suppression of metastatic and angiogenic potential. *Scientific Reports*, 6(1), 36277. <https://doi.org/10.1038/srep36277>
- Lai, K.-H., Chen, P.-J., Chen, C.-C., Yang, S.-H., El-Shazly, M., Chang, Y.-C., Wu, Y.-H., Wu, Y.-H., Wang, Y.-H., Hsieh, H.-L., & Hwang, T.-L. (2021). *Lophatherum gracile* Brongn. attenuates neutrophilic inflammation through inhibition of JNK and calcium. *Journal of Ethnopharmacology*, 264, 113224. <https://doi.org/10.1016/j.jep.2020.113224>
- Lee, S.-J., Jang, S.-A., Kim, S. C., Ryuk, J. A., & Ha, H. (2022). *Lophatherum gracile* Bronghiart Suppresses Receptor Activator of Nuclear Factor Kappa-B Ligand-Stimulated Osteoclastogenesis and Prevents Ovariectomy-Induced Osteoporosis. *International Journal of Molecular Sciences*, 23(22), 13942. <https://doi.org/10.3390/ijms232213942>
- Liu, X., Wang, Y., Ge, W., Cai, G., Guo, Y., & Gong, J. (2022). Spectrum–effect relationship between ultra-high-performance liquid chromatography fingerprints and antioxidant activities of *Lophatherum gracile* Brongn. *Food Science & Nutrition*, 10(5), 1592–1601. <https://doi.org/10.1002/fsn3.2782>
- Rohmah, N. N. (2016). *UJI AKTIVITAS ANTIKANKER EKSTRAK AKAR RUMPUT BAMBU (Lophatherum gracile B.) YANG DIEMBANKAN PADA ZEOLIT NaX TERHADAP SEL KANKER PAYUDARA (T47D)*. <http://etheses.uin-malang.ac.id/5497/1/12630059.pdf>
- Sari, S. P. (2014). *Cytotoxic activity of crude extract of bamboo grass leaves (Lophatherum gracile B.) against Artemia salina Leach shrimp larvae and identification of its active compounds*. Maulana Malik Ibrahim State Islamic Univ. of Malang.
- Wulandari, E. (2017). *Uji aktivitas ekstrak kasar etanol dan fraksi n-heksana tanaman rumput bambu (Lophatherum gracile B.) sebagai antimalaria pada parasit Plasmodium falciparum strain 3D7*. Universitas Islam Negeri Maulana Malik Ibrahim

Malang.

Yao, B., Zhang, M., Zhao, S., Yu, H., Zhang, J., & Liu, D. (2025). Research and utilization status of *Lophatherum gracile*: A medicinal and food homologous plant. *Chinese Herbal Medicines*, 17(2), 261–278. <https://doi.org/10.1016/j.chmed.2024.07.006>

Yusuf, H., Novia, H., & Fahrani, M. (2023). Cytotoxic activity of ethyl acetate extract of *Chromolaena odorata* on MCF7 and T47D breast cancer cells. *Narra J*, 3(3), e326. <https://doi.org/10.52225/narra.v3i3.326>

Zhang, P., Chun, Z., Shao, Q., Fu, L., Luo, Y., Gu, D., & Chen, R. (2021). Evaluation of the phytochemicals and antioxidant activity of *Lophatherum gracile* Brongn based on chemical fingerprinting by HPLC with electrochemical detection. *Journal of Separation Science*, 44(20), 3777–3788. <https://doi.org/10.1002/jssc.202100318>