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PHYTOCHEMICAL SCREENING AND EVALUATION OF ANTIOXIDANT, ANTIBACTERIAL, AND ANTI-INFLAMMATORY ACTIVITIES OF *BAMBUSA VULGARIS* LEAF EXTRACTS

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Abstract

Because of its therapeutic qualities, *Bambusa vulgaris*, also referred to as yellow bamboo, is frequently used in traditional medicine. Using ethanol and acetone as two distinct solvents, the current study sought to assess the phytochemical makeup and biological activity of *Bambusa vulgaris* leaf extracts. Key secondary metabolites such as flavonoids, alkaloids, tannins, saponins, carbohydrates, and proteins were detected by preliminary phytochemical screening. For the majority of phytoconstituents, ethanol outperformed the other solvent in terms of extraction efficiency, indicating that it is better suited to solubilize a wide variety of bioactive substances.

The phosphomolybdenum assay was used to evaluate the extracts' antioxidant activity. The results showed that the ethanol extract had a substantially higher total antioxidant capacity than the acetone extract, indicating a stronger capacity to scavenge free radicals. The disc diffusion method was used to assess antibacterial efficacy against two bacterial strains, *Streptomyces erythraeus* and *Bacillus subtilis*. In both bacteria, the ethanol extract generated bigger zones of inhibition, indicating more potent antimicrobial action. Additionally, the protein denaturation inhibition assay was used to assess the anti-inflammatory effect. Its substantial anti-inflammatory action was further supported by the results, which demonstrated a clear dose-dependent response with the ethanol extract showing higher suppression of protein denaturation.

The study concludes that *Bambusa vulgaris* is a viable natural medicinal agent source that possesses anti-inflammatory, antibacterial, and antioxidant qualities. A scientific foundation for the use of ethanol in the creation of plant-based pharmaceutical and nutraceutical products was established when it was discovered to be a more efficient solvent for removing bioactive components from Bambusa vulgaris leaves.

Keywords: *Bambusa vulgaris*, Phytochemicals, Antioxidant, Antibacterial, Secondary Metabolites

1. Introduction

For thousands of years, plants have been essential to people, offering food, shelter, and medicine. The value of plants in treating and preventing a wide range of illnesses is demonstrated by their therapeutic use in traditional medical systems around the world. Herbs,

shrubs, and trees have long been used as natural treatments for their therapeutic qualities, and many modern pharmaceutical medications are derived from plant-based substances. Because of their efficacy and abundant phytochemical potential, medicinal plants are still used in contemporary complementary and alternative medicine(Atanasov et al., 2015). Bamboo is one of the most useful and adaptable plant groups in nature. It belongs to the Poaceae family of grasses. It is well-known for its therapeutic value in addition to its ecological and economic significance. Bamboos are woody perennial grasses that grow quickly and are found in tropical and subtropical climates. Several species are utilized for food, medicine, building, and handicrafts in traditional practices throughout Asia, Africa, and South America. The plant is a desirable choice for sustainable production and use due to its adaptability and quick development(Liese and Kohl 2015).

One of the most popular bamboo species is *Bambusa vulgaris*, also known as yellow bamboo. Although it originated in tropical Asia, it is currently grown around the world, especially in portions of Africa, China, India, Indonesia, and Sri Lanka. Tall, hollow, yellowish-green culms with distinct internodes and nodes, as well as slender, lanceolate leaves, are the plant's defining features. Its sturdy, flexible stems are utilized in building, furniture, basketry, and the paper industry, and its beautiful appearance makes it a favorite choice for decorative landscaping. (Benjamin et al., 2021).

In addition to its industrial use, *Bambusa vulgaris* is widely used in traditional medical systems. Its young culms, leaves, and shoots have been used to treat a variety of illnesses. The plant has long been used by practitioners of folk medicine to treat skin diseases, infections, wounds, fevers, and respiratory disorders. Additionally, it is thought to lessen inflammation, aid in detoxification, and support digestive health. The existence of many phytochemicals with bioactive qualities is responsible for these therapeutic uses(Fitri et al., 2020).

Bambusa vulgaris has a phytochemical composition that includes alkaloids, flavonoids, phenolic compounds, tannins, saponins, and glycosides. It is well known that these naturally occurring substances have a variety of biological impacts. For instance, flavonoids and phenolic acids are known to have strong antioxidant properties that aid in scavenging dangerous free radicals and shielding cells from oxidative stress. The plant's therapeutic potential is enhanced by the antibacterial and anti-inflammatory properties of its tannins and alkaloids. Conversely, saponins and glycosides are linked to a number of physiological advantages, such as immunological regulation and cholesterol reduction(Jha et al., 2024).

Bambusa vulgaris's antioxidant qualities are especially important in light of contemporary health issues. Chronic diseases like diabetes, cancer, cardiovascular ailments, and neurodegenerative conditions are all significantly influenced by oxidative stress. Plant-based natural antioxidants are thought to be safer and more potent than synthetic ones. Bamboo has potent chemicals that scavenge free radicals, which makes it a promising ingredient for nutraceuticals and health supplements(Putra et al., 2024).

Bambusa vulgaris has strong antibacterial qualities in addition to antioxidant activities. Its effectiveness against a range of bacterial and fungal species has been documented in numerous research. This backs up its historical application in the treatment of wounds and infections. Plant-derived antimicrobials are becoming more popular as alternative treatments in a time when antibiotic resistance is rising. The capacity of *Bambusa vulgaris* to suppress microbial development and lower the risk of secondary infections is facilitated by its inherent

phytochemicals(Prabula et al., 2024). The anti-inflammatory properties of *Bambusa vulgaris* are another significant biological function. Many degenerative diseases are caused by chronic inflammation, which is also a major factor in inflammatory bowel disease, arthritis, and asthma. The plant contains compounds that have been demonstrated to lower inflammation indicators and lessen inflammatory symptoms(Lodhi et al., 2016).

Bambusa vulgaris is a unique plant species because of its many uses in the industrial, medicinal, and ecological spheres. It has garnered interest from a variety of sectors due to its broad availability, quick growth, and therapeutic potential. Because of its rich phytochemical composition and related biological activity, *Bambusa vulgaris* continues to be a useful natural resource for enhancing health and well-being as interest in plant-based health solutions grows. (Akhtar and Patowary 2022).

Scientific classification

Kingdom: Plantae
Clade: Tracheophytes
Clade: Angiosperms
Clade: Monocots
Clade: Commelinids
Order: Poales
Family: Poaceae
Genus: Bambusa
Species: *B. vulgaris*

2. Materials and Methods

2.1.Sample Collection

From Rangampet, fresh, healthy Bambusa vulgaris leaves were gathered. To retain sensitive phytochemicals, the collected leaves were air-dried in the shade at room temperature for seven to ten days after being properly cleaned with distilled water to get rid of any surface dust or debris. Following drying, the leaves were ground into a fine powder with a mechanical grinder and kept for later use in airtight containers.

2.2.Preparation of Extracts

Ethanol and acetone were used as solvents to remove the powdered leaf material. In sterile conical flasks, 25 grams of the dried leaf powder were individually steeped in 250 milliliters of ethanol and acetone for each extraction. To guarantee the greatest extraction of bioactive chemicals, the flasks were sealed and left at room temperature for 48 to 72 hours, shaking occasionally. To get rid of plant remnants, the solutions were filtered through Whatman No. 1 filter paper after maceration. A water bath set at 40 to 50°C was then used to evaporate the filtrates until they were dry under reduced pressure. After being gathered and weighed, the concentrated extracts were kept at 4°C in sterile containers until additional examination(Azwanida 2015).

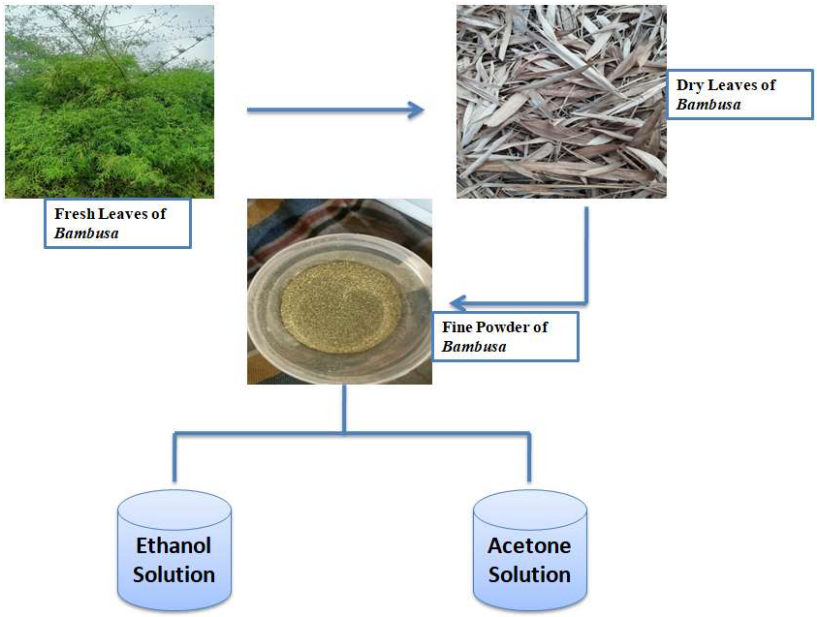

Figure.1 Workflow of *Bambusa vulgaris* leaf extract preparation. Fresh leaves were shade-dried, powdered, and extracted using ethanol and acetone. Extracts were filtered and stored for further use.

2.3.Phytochemical Screening

To determine the existence of significant secondary metabolites, a preliminary phytochemical screening of *Bambusa vulgaris* leaf extracts in ethanol and acetone was conducted. Analytical-grade reagents were used to conduct standard qualitative testing. The existence of particular substances was inferred from observations like color shifts or precipitate formation. Every test was run to make sure it was consistent.

2.3.1. Test for Carbohydrates- Molisch's Test

In a test tube, a few drops of alcoholic α-naphthol solution were combined with two milliliters of the extract. 1 mL of strong sulfuric acid was gently added along the test tube's side without disturbing the contents. It was believed that the presence of carbohydrates was indicated by a violet ring that appeared at the interface between the two layers(García Fernández-Villa et al., 2020).

2.3.2. Test for Saponins- Sodium Bicarbonate Test

Two milliliters of sodium bicarbonate solution, a few drops of distilled water, and one milliliter of the extract were combined. After giving the mixture a good shake, it was let to stand for a few minutes. The observation of a steady, frothy, honeycomb-like foam indicated the presence of saponins(Shaikh and Patil 2020).

2.3.3. Test for Proteins- Xanthoproteic Test

One milliliter of strong nitric acid was added to two milliliters of the extract, and the combination was then slowly cooked in a water bath. The medium was made alkaline by adding a few drops of diluted ammonia solution after it had cooled. Proteins were present because a yellow-colored precipitate formed(Subroto et al., 2020).

2.3.4. Test for Tannins- Lead Subacetate Test

A few drops of a 10% lead subacetate solution were added to two milliliters of the extract. After giving the mixture a gentle shake, any changes were noted. The presence of tannins was

shown by the formation of a creamy, gelatinous precipitate with the addition of the reagent(Geetha and Geetha 2014).

2.3.5. Test for Alkaloids- Mayer's Test

One milliliter of Mayer's reagent was added to two milliliters of the extract after it had been acidified with a few drops of diluted hydrochloric acid. The presence of alkaloids was verified by looking for the formation of a cream-colored or pale yellow precipitate in the mixture. (Sabdoningrum et al., 2021).

2.3.6. Test for Flavonoids- Concentrated Sulfuric Acid Test

A few drops of strong sulfuric acid were applied straight to 2 milliliters of the extract. It was determined that the appearance of orange coloring was proof that flavonoids were present. (Dubale et al., 2023).

2.4.Antioxidant Activity

The phosphomolybdenum test technique was used to measure the plant extracts' overall antioxidant capability. 0.588 mL of concentrated sulfuric acid, 0.049 g of ammonium molybdate, and 0.036 g of sodium phosphate were combined to create the reagent solution. Distilled water was then added to bring the final volume down to 10 mL.

Ten milligrams of the dried extract were dissolved in one milliliter of dimethyl sulfoxide (DMSO) to create a stock solution of the plant extract. In a test tube, 100 µL of the sample and 1 mL of the newly made reagent solution were combined. For ninety minutes, the reaction mixture was incubated at 95°C in a boiling water bath. Following incubation, the samples were allowed to cool to room temperature before a UV-visible spectrophotometer was used to detect the absorbance at 695 nm. The standard reference substance was ascorbic acid (10 mg/mL in DMSO). A percentage of antioxidant activity in relation to the standard was used to express the extracts' phosphomolybdenum reduction potential (PRP) (Prieto et al., 1999). The following was used to determine the % inhibition:

$$Antioxidant\ Activity\ \% = Control - Sample/Control \times 100$$

2.5.Antibacterial Activity

The disc diffusion method was used to evaluate the antibacterial activity of *Bambusa vulgaris* leaf extracts in ethanol and acetone against the *Streptomyces erythraeus* bacterial strain. After preparing the nutrient agar medium and pouring it onto sterile Petri dishes (20–25 mL per plate), it was allowed to solidify at room temperature. To guarantee consistent bacterial growth, a sterile cotton swab was used to equally distribute a fresh suspension of *Streptomyces erythraeus* across the agar's surface. Twenty microliters of each plant extract at doses of 25, 50, and 100 µg/mL were deposited onto sterile filter paper discs (6 mm in diameter). Sterile forceps were used to carefully place these discs on the inoculated agar surface. Negative controls were solvent-only discs, and positive controls were antibiotic discs containing abikicin.

Every plate was incubated for twenty-four hours at 37°C. Following incubation, the diameter of the zone of inhibition surrounding each disc was measured in centimeters (cm) to assess the antibacterial activity(Bauer 1996).

2.6.Anti-inflammatory Activity

A final volume of 5 mL was obtained by mixing 200 µL of Bovine Serum Albumin (BSA) solution, 2.8 mL of phosphate buffer (pH 7.4), and 2 mL of the plant extract (ethanol or

acetone). To cause protein denaturation, the mixture was heated in a water bath at 70°C for 15 minutes after being incubated at 37°C for 30 minutes. The anti-inflammatory activity of the solution was evaluated by measuring its turbidity at 660 nm after it had cooled to room temperature(Drăgan et al., 2016).

3. Results

3.1.Phytochemical Screening

Both ethanol and acetone leaf extracts of *Bambusa vulgaris* were shown to be capable of extracting multiple classes of bioactive chemicals, but with differing degrees of efficiency, according to a comparative phytochemical investigation. The presence of a violet ring in the Molisch's test indicated that carbohydrates were found in both ethanol and acetone extracts at a high level (++). This suggests that the carbohydrate molecules in *Bambusa vulgaris* leaves can be extracted with comparable effectiveness using both polar solvents.

Regarding saponins, the acetone extract only shown a weak presence (+), but the ethanol extract demonstrated a strong presence (++). Because ethanol is more compatible with glycosidic structures, it is more effective at extracting saponins, as evidenced by the stable honeycomb-like froth that forms in the ethanol extract as opposed to the weaker foaming in acetone.

Based on the yellow precipitate seen in the xanthoproteic test, proteins were determined to be marginally present (+) in the acetone extract and significantly present (++) in the ethanol extract. Given its superior solubility and less denaturing effects on proteinaceous substances, this discrepancy suggests that ethanol is a better solvent for protein extraction.

Following treatment with lead subacetate, a creamy, gelatinous precipitate formed, indicating that both the ethanol and acetone extracts exhibited high present (++) for tannins. This implies that tannins can be extracted in both ethanol and acetone with little change because they are mildly polar. Likewise, it was discovered that both extracts had a high concentration of alkaloids (++). According to Mayer's test, both solvents are equally effective at removing alkaloid chemicals from *Bambusa vulgaris* leaves when a cream-colored precipitate forms.

Nonetheless, there was a noticeable variation in the flavonoid extraction process. The level of orange coloration in the concentrated sulfuric acid test indicated that the acetone extract had a high presence (++), but the ethanol extract had a more highly present (+++) reaction. This demonstrates how well ethanol extracts flavonoids, probably as a result of its greater polarity and capacity to dissolve phenolic structures(Singh et al., 2025). As shown in Table.1

Table.1 Preliminary phytochemical screening of *Bambusa vulgaris* leaf extracts using ethanol and acetone as solvents.

S. No.	Phytochemicals	Test	Observation	Extract Results	
				Ethanol	Acetone
1	Carbohydrates	Molisch's test	violet ring	++	++
2	Saponins	$NaHCO_3$ Test	A honey comb like structure	++	+

3	Proteins	Xanthoproteic Test	A yellow colour precipitate	++	+
4	Tannins	Lead Sub acetate Test	A creamy gelatinous precipitate	++	++
5	Alkaloids	Mayer's Test	A cream white precipitate	++	++
6	Flavonoids	Conc.H_2SO_4 Test	Orange colour	+++	++
Note: + = Present; ++ = Moderately present; +++ = Highly present					

3.2.Antioxidant Activity

The antioxidant activity of the ethanol extract was 72% at a concentration of 25 µg/mL, whereas the acetone extract had a slightly lower value of 66%. This suggests a larger presence of antioxidant phytochemicals such polyphenols and flavonoids because the ethanol extract shown a superior ability to decrease molybdenum (VI) to molybdenum (V) even at low concentrations.

Both extracts' antioxidant capacity somewhat decreased at 50 µg/mL. Inhibition was 60% in the ethanol extract and 52% in the acetone extract. The ethanol extract's ongoing dominance at this stage demonstrates how well it extracts bioactive substances that support redox reactions in the phosphomolybdenum assay.

A further decline in activity was noted at 75 µg/mL. Whereas the acetone extract showed 36% inhibition, the ethanol extract obtained 45% inhibition. The ethanol extract retained a noticeably stronger antioxidant effect than its acetone counterpart, despite the fact that both extracts displayed decreased activity when compared to lower concentrations. The ethanol extract showed 30% inhibition and the acetone extract 24% at the maximum tested concentration of 100 µg/mL. As seen in certain natural extracts, the decreasing trend can be the result of antioxidant component saturation or decreased radical scavenging effectiveness at greater doses. Ethanol, however, continued to be the most effective solvent for removing antioxidant components from *Bambusa vulgaris* leaves.

In terms of antioxidant activity, the ethanol extract continuously beat the acetone extract at all doses. This implies that ethanol was superior to acetone in its ability to extract antioxidant-rich phytochemicals such as flavonoids, tannins, and phenolic acids because it is more polar. Both extracts demonstrated moderate antioxidant potential when compared to the standard (ascorbic acid), with the ethanol extract performing very similarly to the standard at lower concentrations. (Tripathi et al., 2015). As shown in Table.2 and Figure.2

Table.2 Total antioxidant capacity of *Bambusa vulgaris* leaf extracts (ethanol and acetone) determined by the phosphomolybdenum assay at different concentrations. The results are expressed as percentage antioxidant activity.

***Note. Error bars are shown as standard deviations**

S.no	Concentration (µg/mL)	Extracts(%)	
		Ethanol	Acetone
1.	25	72	66
2.	50	60	52
3.	75	45	36
4.	100	30	24

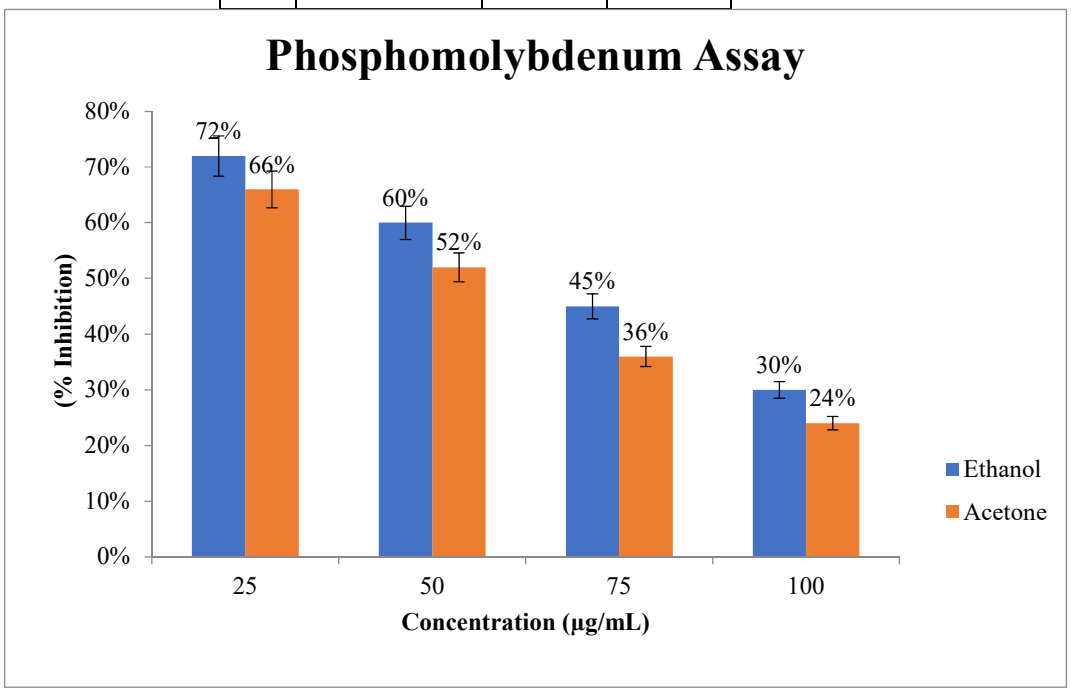

Figure.2 Total antioxidant activity of *Bambusa vulgaris* leaf extracts using ethanol and acetone, evaluated by the phosphomolybdenum assay at varying concentrations (25–100 µg/mL). The antioxidant activity is expressed as percentage inhibition (%). Ethanol extract exhibited higher activity at all tested concentrations compared to acetone extract.

3.3.Antibacterial Activity

Using ethanol and acetone as solvents, the antibacterial activity of *Bambusa vulgaris* leaf extracts was assessed against *Streptomyces erythraeus* and *Bacillus subtilis* at concentrations of 25, 50, and 100 µg/µL, with a control concentration for comparison. Centimeters (cm) were used to measure the zone of inhibition.

With increasing concentration, the ethanol extract's antibacterial efficacy against *Bacillus subtilis* increased gradually. The inhibition zone was 1.6 cm at 25 µg/µL, 1.8 cm at 50 µg/µL, and 1.9 cm at 100 µg/µL, demonstrating a definite dose-dependent impact. At 25 µg/µL, 50 µg/µL, and 100 µg/µL, the acetone extract likewise demonstrated increasing activity, measuring 1.5 cm, 1.7 cm, and 1.8 cm, respectively. Nonetheless, the ethanol extract continuously shown marginally stronger antibacterial activity than the acetone extract at every concentration. Both extracts were substantially more effective than the baseline, as seen by the control's 1.2 cm zone of inhibition.

A similar pattern was noted for *Streptomyces erythraeus*. At 25, 50, and 100 µg/µL doses, the ethanol extract displayed inhibition zones of 1.5 cm, 1.6 cm, and 1.7 cm, respectively. At the same doses, the acetone extract produced somewhat smaller inhibitory zones of 1.4 cm, 1.5 cm, and 1.6 cm. Ethanol extracts were again performed better than acetone extracts, despite the small differences, indicating a somewhat higher effectiveness of ethanol in removing antimicrobial components from *Bambusa vulgaris*. A zone of 1.2 cm was also observed by the control for this organism, highlighting the significant antibacterial activity of both extracts, especially the ethanol-based ones.

All things considered, the results show that ethanol extracts outperformed acetone extracts against the two bacterial strains, and that antibacterial activity rose as extract concentration rose. Ethanol proved to be the best extraction solvent, and *Bambusa vulgaris* showed significant promise as a source of bioactive chemicals against both tested Gram-positive bacteria. The extract was effective over both tested bacterial strains, according to zones of inhibition (Table 3). (Zhiang et al., 2019). As shown in Tables 3, 4 and Figures 3, 4

Table.3 Antibacterial activity of *Bambusa vulgaris* ethanol and acetone extracts against *Bacillus subtilis* at different concentrations.

S.No	Concentration (µg/µL)	Zone of Inhibition (cm)	
		Ethanol	Acetone
1.	Control	1.1	1.1
2.	25	1.6	1.5
3.	50	1.8	1.7
4.	100	1.9	1.8

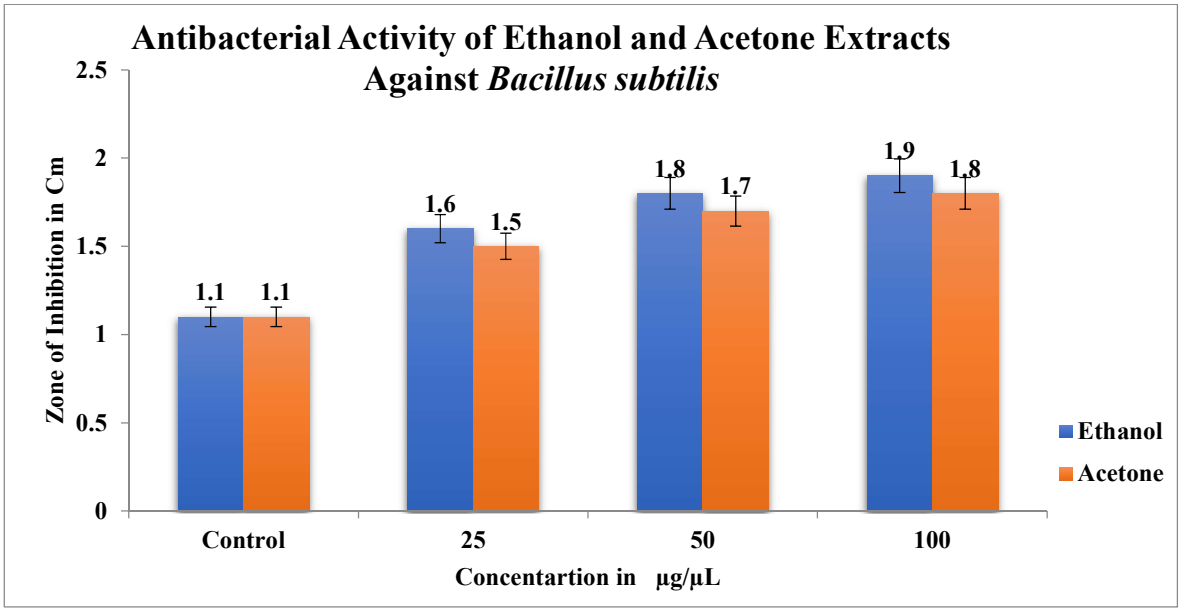

Figure.3 Zone of inhibition (cm) showing antibacterial activity of ethanol and acetone extracts of *Bambusa vulgaris* against *Bacillus subtilis.* Ethanol extract exhibited greater inhibitory effect compared to acetone at all tested concentrations.

Table.4 Antibacterial activity of *Bambusa vulgaris* ethanol and acetone extracts against *Streptomyces erythraeus* at different concentrations.

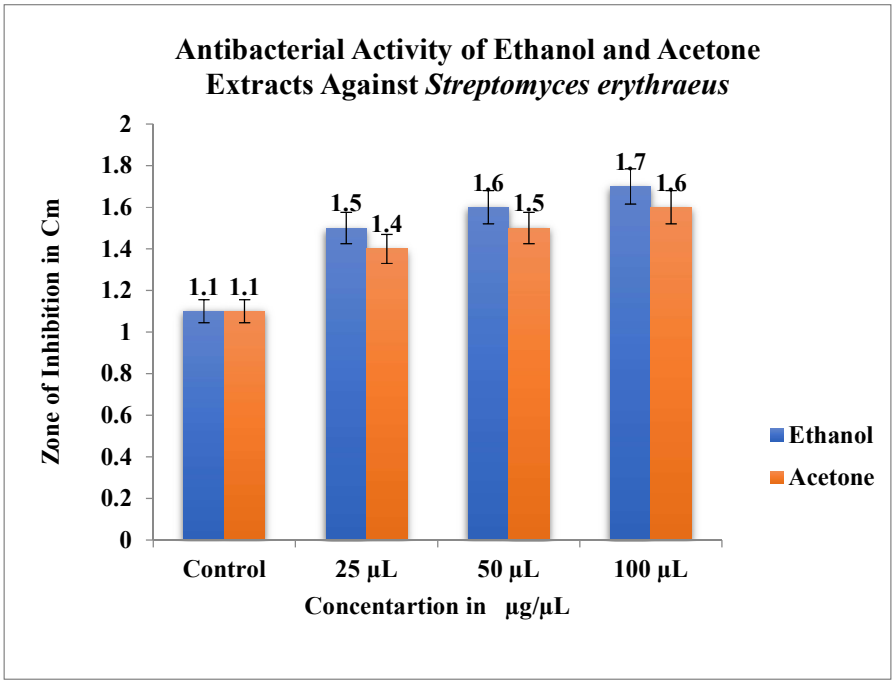

Figure.4 Zone of inhibition (cm) showing antibacterial activity of ethanol and acetone extracts of *Bambusa vulgaris* against *Streptomyces erythraeus.* Ethanol extract exhibited greater inhibitory effect compared to acetone at all tested concentrations.

3.4.Anti-inflammatory Activity

Using ethanol and acetone as solvents, the anti-inflammatory properties of leaf extracts from *Bambusa vulgaris* were examined at different concentrations. The ethanol-based extract demonstrated a greater initial reaction at a dosage of 25 µg/mL, exhibiting 10% inhibition, which was somewhat higher than the 6% inhibition seen in the acetone extract. Both extracts showed enhanced activity as the concentration rose to 50 µg/mL; the ethanol extract achieved a 22 percent inhibition, while the acetone extract only achieved a 16 percent inhibition, continuing the trend of ethanol exhibiting superior potency.

The acetone extract also improved to 26% inhibition, while the ethanol extract showed a further rise in activity with 30% inhibition at 75 µg/mL. At this point, the gap decreased, but the ethanol extract still performed better. The ethanol extract demonstrated its greatest activity of 38% inhibition at the highest tested concentration of 100 µg/mL, while the acetone extract showed 34%. Both extracts' steady dose-dependent increase indicates a definite concentration-dependent impact. Across all studied concentrations, ethanol extract consistently outperformed acetone, indicating that ethanol is a more effective solvent for removing anti-inflammatory substances from *Bambusa vulgaris* leaves. Protein denaturation was inhibited by the extract in a concentration-dependent manner(Santram Lodhi et al., 2016). As shown as in Table 5 and Figure 5

Table.5 Anti-inflammatory activity of *Bambusa vulgaris* leaf extracts at different concentrations, evaluated by BSA protein denaturation assay.

S.no	Concentration (µg/mL)	Extracts %	
		Ethanol	Acetone
1.	25	10	6
2.	50	22	16
3.	75	30	26
4.	100	38	34

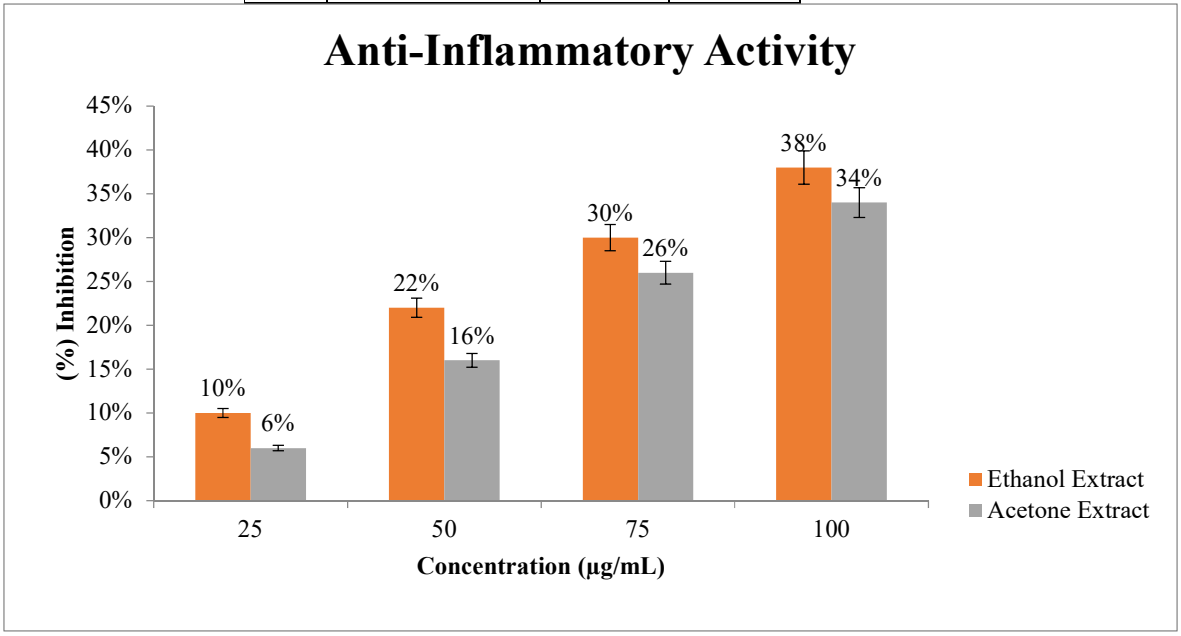

Figure.5 Anti-inflammatory activity of *Bambusa vulgaris* leaf extracts at different concentrations, assessed by BSA protein denaturation assay. The activity is expressed as percentage inhibition.

4. Discussion

Several significant groups of secondary metabolites were found in *Bambusa vulgaris* leaf extracts after phytochemical screening. Both ethanol and acetone extracts contained compounds such flavonoids, alkaloids, tannins, carbohydrates, proteins, and saponins. But when it came to extracting a wider and more plentiful variety of phytochemicals, ethanol consistently outperformed acetone as a solvent. This is explained by the fact that ethanol is polar, which improves its capacity to dissolve polar and somewhat non-polar phytoconstituents(Ogunmoyole 2022). The ethanol extract outperformed the acetone extract in terms of antioxidant activity, lowering oxidative stress indicators more effectively. This suggests that ethanol was more effective at removing antioxidants that are known to scavenge free radicals, such as flavonoids and phenolic acids. The greater antioxidant ability of ethanol extract indicates that it has greater potential to fight oxidative damage and associated illnesses(Benjamin et al., 2023).

The effectiveness of ethanol as a superior extraction solvent was further validated by the antibacterial analysis. Although the examined bacterial strains were inhibited by both extracts, the ethanol extract generated noticeably greater zones of inhibition. This implies that the ethanol extract contains more antibacterial chemicals or has a higher efficacy. Even while the difference was occasionally small, it always favored ethanol, demonstrating how well it extracts antibiotic chemicals(Zhiang et al., 2019).

Additionally, there was a similar pattern in the anti-inflammatory activity. Stronger inhibition of protein denaturation was demonstrated by the ethanol extract, suggesting improved anti-inflammatory activity. This indicates that the ethanol extract has more bioactive substances that can stabilize proteins and stop inflammatory reactions. A dose-dependent effect was also shown by the activity's progressive rise with concentration, which was more noticeable in the ethanol extract(Elekofehinti et al., 2023).

Bambusa vulgaris leaves extracted with ethanol showed more biological and phytochemical activity than those extracted with acetone. According to these results, ethanol is a better solvent to use when removing pharmacologically active substances from this plant. This demonstrates how it could be used to create herbal remedies for inflammatory diseases, microbial infections, and oxidative stress. Ethanol is a popular extraction medium in natural product research, as evidenced by its consistent superiority across several experiments.

5. Conclusion

This study successfully illustrates the biological and phytochemical importance of *Bambusa vulgaris* leaf extracts, particularly with regard to their anti-inflammatory, antibacterial, and antioxidant qualities. The extraction efficiency was assessed using ethanol and acetone as solvents; ethanol outperformed the two in terms of phytochemical output and bioactivity. In comparison to the acetone extract, the ethanol extract showed a wider range and greater intensity of phytochemical elements, such as flavonoids, alkaloids, saponins, and proteins.

The increased activity of the ethanol extract was further validated by biological tests. Ethanol continuously shown greater activity in the phosphomolybdenum assay, an antioxidant screening method, indicating a larger concentration of phenolic chemicals. Similarly, the ethanol extract generated wider zones of inhibition than the acetone extract in antibacterial testing against *Streptomyces erythraeus* and *Bacillus subtilis*. Because flavonoids and similar polyphenols prevent protein denaturation, the anti-inflammatory experiment also showed a stronger inhibitory response with ethanol.

Bambusa vulgaris is a promising medicinal plant with significant pharmacological potential, according to the study's overall findings. It is advised to use ethanol as the ideal solvent while removing bioactive substances. These results provide a scientific foundation for the plant's possible use in the creation of natural medications and therapeutic formulations, as well as supporting the plant's traditional medicinal uses. Its complete biomedical potential requires more research, including chemical isolation and mechanistic analyses.

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Conflict of Interest

The authors declare no conflict of interest.

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