Antibacterial activity of the aqueous rhizome extract of *Alpinia galanga* (L.) Willd (*Kaluwala*) used in Sri Lankan Indigenous Medicine

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Abstract

Alpinia galanga (*Kaluwala*) is frequently used in Sri Lankan Indigenous Medicine to treat skin infections, inflammatory disorders, and respiratory conditions. Traditionally, healers employ cold-water preparations of the rhizome, but these methods have limited scientific validation. Therefore, this study was conducted to assess the antibacterial and antifungal properties of an aqueous rhizome extract of *A. galanga* prepared using traditional methods. Shade-dried rhizomes were soaked in sterile cold water, filtered, and analyzed for yield and phytochemical composition. Antimicrobial activity was evaluated using the agar-well diffusion technique against *Streptococcus pneumoniae* (ATCC 12386), Staphylococcus aureus (ATCC 25923), *Escherichia coli* (ATCC 25922), methicillin-resistant *Staphylococcus aureus* (MRSA), and *Candida albicans* (ATCC 10231). Amoxicillin and fluconazole were used as positive controls. Phytochemical analysis revealed the presence of alkaloids, flavonoids, tannins, saponins, glycosides, and phenolic compounds. The extract inhibited the growth of all tested bacteria, including MRSA, but showed no activity against *C. albicans.* The largest inhibition zones were recorded for *S. aureus* (14.3 ± 0.6 mm), followed by *S. pneumoniae* (12.4 ± 0.5 mm), MRSA (11.8 ± 0.5 mm), and *E. coli* (10.2 ± 0.4 mm). Conclusion: The aqueous rhizome extract of *A. galanga* exhibits broad-spectrum antibacterial activity, supporting its traditional use for infected skin lesions. Further pharmacological, phytochemical, and formulation studies are warranted.

Keywords: *Alpinia galanga*, *Kaluwala*, aqueous extract, antibacterial activity, Indigenous Medicine, MRSA

Introduction

Alpinia galanga (L.) Willd., commonly referred to as *Kaluwala* in Sri Lanka, belongs to the Zingiberaceae family and is traditionally used in indigenous and Ayurvedic medicine to address skin infections, abscesses, inflammatory conditions, digestive disorders, fever, and respiratory ailments[1–3]. Cold aqueous preparations of the rhizome, such as pastes, juices, and decoctions, are commonly applied to treat skin lesions thought to have microbial origins.

Phytochemical investigations have shown that *A. galanga* rhizomes contain flavonoids, phenolic compounds, essential oils, tannins, terpenoids, and diarylheptanoids. Certain constituents, including galangin, 1′-acetoxychavicol acetate, and eugenol, have exhibited antibacterial properties in vitro[4–7]. However, most studies have focused on alcoholic extracts or essential oils rather than cold-water preparations traditionally used by healers.

With the global increase in antibiotic-resistant strains such as methicillin-resistant Staphylococcus aureus (MRSA), it is crucial to explore traditional remedies as potential antibacterial agents[8–10]. The current study investigates the antibacterial and antifungal activity of a cold aqueous rhizome extract of *A. galanga* prepared according to traditional methods.

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Materials and Methods

Plant collection and authentication

Fresh rhizomes of *A. galanga* were harvested from Gampaha District, Sri Lanka. A botanist authenticated the plant, and a voucher specimen was deposited in the University of Indigenous Medicine herbarium.

Preparation of aqueous extract

Rhizomes were washed, sliced, and shade-dried for 7 days. Fifty grams of dried slices were soaked in 150 mL of sterile distilled water at room temperature for 24 h, manually crushed, and filtered through sterile gauze followed by Whatman No. 1 filter paper. The filtrate was stored at 4 °C.

The filtrate was evaporated at 40 °C to obtain a dry extract. The extraction yield (%) was calculated as:

$$\text{Yield (\%)} = \frac{\text{Dry extract weight}}{\text{Raw material weight}} \times 100$$

The obtained yield was 4.8% w/w.

Phytochemical screening

Qualitative tests were performed to detect:

Alkaloids: Dragendorff's test

Phenolics: Ferric chloride test

Flavonoids: Shinoda test

Tannins: Gelatin test

Saponins: Froth test

Glycosides: Keller–Killiani test

Terpenoids: Salkowski test

Selected microorganism

The tested organisms were *S. pneumoniae* (ATCC 12386), *S. aureus* (ATCC 25923), *E. coli* (ATCC 25922), MRSA (clinical isolate), and *C. albicans* (ATCC 10231).

Antimicrobial assay

Well diffusion was carried out using Mueller-Hinton agar for bacteria and Sabouraud agar for yeast. Wells (6 mm in diameter) were loaded with 10 µL of aqueous extract, amoxicillin (10 µg/mL), fluconazole (25 µg/mL), or sterile saline (negative control). Plates were incubated at 37 °C for 18–24 h, and inhibition zones were recorded in millimeters. All experiments were performed in triplicate.

Statistical analysis

Results are expressed as mean ± SD from three independent experiments.

Results

Phytochemical profile

The extract contained alkaloids, flavonoids, tannins, saponins, glycosides, and phenolic compounds; terpenoids were not detected.

Antimicrobial action

Table 1 summarizes the inhibition zones and the Bar chart representation of zone of inhibition. The extract inhibited all bacterial strains, including MRSA, but did not show activity against *C. albicans*.

Table 1: Summarized inhibition zones

Microorganism	Extract	Positive control	Negative control
S. pneumoniae	12.4 ± 0.5	28.1 ± 0.7	0
E. coli	10.2 ± 0.4	22.6 ± 0.5	0
S. aureus	14.3 ± 0.6	30.4 ± 0.6	0
MRSA	11.8 ± 0.5	0	0
C. albicans	0	19.7 ± 0.5	0

Discussion

The cold aqueous extract of *A. galanga* exhibited significant antibacterial activity, especially against *S. aureus* and *S. pneumoniae*, corroborating its traditional use for skin infections. Activity against MRSA is noteworthy, considering the clinical challenges posed by antibiotic resistance. Polar phytochemicals such as flavonoids, phenolics, and saponins likely account for the antibacterial effect[11–14].

The absence of antifungal activity may be due to the lack of non-polar terpenoids, which are more effectively extracted with organic solvents. Although inhibition zones were smaller than those produced by amoxicillin, the results indicate that traditional cold-water macerations preserve bioactive compounds, supporting ethnomedical practices.

Future studies should:

Determine minimum inhibitory (MIC) and bactericidal concentrations (MBC).

Isolate and identify active constituents using HPLC or GC-MS.

Assess safety profiles in vitro and in vivo.

Develop standardized formulations suitable for clinical use.

Conclusion

The cold aqueous extract of *A. galanga* rhizome displays broad antibacterial activity, including against MRSA, validating its traditional use for infected skin conditions. Further pharmacological and phytochemical studies are recommended.

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