RESEARCH ARTICLE

ANTIBACTERIAL ACTIVITY OF ALOE LANATA AND ALOE VACILLANIS PLANT EXTRACTS

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Abstract

This study was conducted to evaluate the antibacterial effect of the aqueous and Methanolic extracts of Aloe Lanata and Aloe Vacillanis. Using agar diffusion method, three different concentrations of Aloe extracts were evaluated on Staphylococcus aureus, Escherichia. coli, Pseudomonas aeruginosa, and to compare the effectiveness of extracts with some antibiotics (Ampicillin: Amp, Erythromycin: Erytho, Gentamycin: Genta). The extracts showed that there was a different effect on the bacterial species according to the type and concentration of the plant extract as well as the inhibitory response to the bacterial species. The aqueous and alcoholic extract of A. lanata is more potent than A. vacillanis extract. In comparison to the type of extract, the alcoholic extract of A. lanata was more effective than the aqueous extract, while the aqueous extract of the A. vacillanis showed higher efficacy than the alcoholic extract. Both extracts had the most substantial effect on both E. coli and P. aeroginosa and were less effective on S. aureus. Antibacterial efficacy of studied plant extracts showed better efficacy than the antibiotic (Ampicillin, Erythromycin) on Staphylococcus aureus and E. coli.

Keywords: Aloe Lanata, Aloe Vacillanis, antibacterial activity, antibiotics, bacteria.

1. Introduction

The Aloe family (Family Liliaceae) includes more than 600 known species of Aloe. These are indigenous medicinal, herb growing in tropical and subtropical areas. Many of Aloe species have been used as botanical medicines in many countries for thousands of years [1,2]. The Aloe vera gel contains about 99.3% water, 0.7% glucose, and many other constituents.

Chemical analysis reveals that the Aloe plant contains various organic and inorganic components. The gel extract of A. vera presents various pharmacological properties such as promoting and healing wound and burn, frost-bite healing, gastro-intestinal problems, skin diseases, constipation with addition to having antiinflammatory, antifungal, hypoglycemic and gastroprotective properties [3, 4].

A. vacillans Forssk (1775) is a caulescent shrub plant that belongs to the Aloe family, this species is naturally endemic to Yemen and Saudi Arabia [5]. In Yemen is grown on mountainous areas and used as a remedy for treatment of various diseases. Fresh leaf extract of A. vacillans was more potent and active against S. aureus, Micrococcus luteus, Klebsiella oxytoca, Proteus mirabilis, and Candida albicans compared to the dry leaf extract. The A. vacillans extract was no effective against Klebsiella pneumonia, Shigella flexneri, and P. aeruginosa [5].

Aloe lanata McCoy & Laveran (2007) is perennial shrub Succulent, a stemless plant, that is species of Aloe and is endemic to Yemen. It found at 2100 meter on mountains and people use it to cure various illnesses. There is not any information or previous studies about antibacterial activity of A. lanata.

This study aims to investigate the effect of Yemeni endemic two Aloe species Aloe lanata and Aloe vacillans on three selected bacterial species.

2. Materials and Methods

2.1 Plant materials

The leaves of Aloe vacillans and Aloe lanata were collected from Aldhala mountain, Yemen, and identified by the Dr. Al-hushabi Othman, at the Biology Department, Faculty of
Science, University of Aden. The plant leaves have been washed thoroughly 2-3 times under running tap water and then sterile distilled water. The leaves dried in shaded area for 70 days and then manually grind and stored at room temperature.

2.2 Preparation of extract

The powdered material was subjected to hot maceration extraction method, successively with different known solvents in increasing order of polarity; methanol and water. Each time before extracting with next solvent, the powdered material was dried. Each extract was then concentrated by evaporation of the solvent on the water bath [6, 7]. The extracts were dissolved in Dimethyl Sulfoxide (DMSO) to give a concentration of 200 mg/ml.

Mullar Hinton agar plates separately, after which well was punched in the plates by a sterile borer (6 mm diameter). Three bacterial strains were inoculated by spreading on the surface of the media, then the results were determined by measuring mean of the zone of inhibition in mm.

The commercial antibiotic discs used in our study were reported by Sulaiman et al [5]. They showed that the soluble extracts of Aloe vera inhibited 62.5% of the examined microbes, and observed, the fresh leaf extract was more potent and active against *Staphylococcus aureus*, *Micrococcus luteus*, *Klebsiella oxytoca*, *Proteus mirabilis*, and *Candida albicans* compared to the dry leaf extract [5].

The methanolic extract showed higher activity on *Staphylococcus aureus* and *Escherichia coli*, where the diameter zones of inhibition were 12.67 ± 0.9 mm at 30mg aqueous extract concentration than its effect on *Staphylococcus aureus*, where the diameter zone of inhibition was 9.67 ± 0.6 mm at the same concentration, Table 2.

The results shows the inhibition activities of aqueous and methanolic extracts obtained from the leaves of *Aloe vacillans* against tested bacterial species, (table 3, 4). They revealed that the aqueous and methanolic extracts were affected *Staphylococcus aureus* and *Escherichia coli*, than *Staphylococcus aureus*. The diameter zones of inhibition were 15 ± 1.3 mm and 15.33 ± 0.9 mm respectively by 30mg aqueous extract concentration (Table 3), and 12.33 ± 1.3 mm with *Pseudomonas aeruginosa* and *Escherichia coli* by 30mg methanolic extract concentration. The antimicrobial activity of the extracts can be attributed to structural variations in the precipitated bioactive components from *A. vacillans* plants.

The activity index for each extract was calculated using following formula [10]:

\[
\text{Activity Index (AI)} = \frac{\text{inhibition Zone of the sample}}{\text{inhibition Zone of the standard}}
\]

, and was presented in Table 5.

Previous and alone studies of antibacterial activity of *Aloe vacillans* were reported by Sulaiman et al [5]. They showed that the solvent extracts of *Aloe vacillans* inhibited 62.5% of the examined microbes, and observed, the fresh leaf extract was more potent and active against *Staphylococcus aureus*, *Micrococcus luteus*, *Klebsiella oxytoca*, *Proteus mirabilis*, and *Candida albicans* compared to the dry leaf extract [5].

Our results agree with those of previous studies, who found *Escherichia coli*, *Staphylococcus aureus*, and *Candida albicans* were susceptible to the crude extract of aloe vera gel but variations may occur depending on the type of extraction method used.

They reported the aqueous extracts were active in inhibiting the growth of *Escherichia coli*, *Staphylococcus aureus*, and *Candida albicans*, whereas the methanol extraction method inhibited the growth of *Escherichia coli* but did not inhibit *Staphylococcus aureus* and *Candida albicans*. [4, 11, 12, 13]

The commercial antibiotic discs used in our study were erythromycin, gentamicin, and ampicillin to comparing the antibiotic effect with extracts on tested bacterial species. The results presented in Table 5, showed various degrees in antibiotic resistance

and activity index. *Staphylococcus aureus* showed resistance to ampicillin and *Escherichia coli* was resistant to erythromycin, weakly sensitive to ampicillin. The
The inhibition zone diameter of ampicillin was about 9 mm on *Escherichia coli*, whereas aqueous and methanolic extract of two studied Aloe species showed about 14.33 mm and 15.33 mm stronger than the efficacy of ampicillin and erythromycin on *Escherichia coli*. The efficacy of two solvent extracts was weak on *Staphylococcus aureus* but was best than ampicillin antibiotic. A significant susceptibility pattern was observed with the extracts of *Aloe vacillans* and *Aloe lanata* against gram-negative bacteria, including *Escherichia coli* and *Pseudomonas aeruginosa*. The susceptibility of these tested bacterial species strongly suggests that the compounds can be utilized against emerging microbes that are multidrug-resistant to synthetic antibiotics [14, 15, 16]. Other studies revealed the antibacterial activity of Aloe species on both Gram-positive and Gram-negative. Waithaka et al (2018) reported the extracts from *Aloe vera*, *Aloe volkensii* and *Aloe secundiflora* inhibited the growth of *Staphylococcus aureus*, *Bacillus subtilis*, *Klebsiella pneumonia*, *Escherichia coli* [17].

**Table (1):** Antibacterial activity of *Aloe Lanata* Aqueous Extract on Tested Microorganisms

| Microorganisms   | Inhibition Zones diameter [mm] | Antibiotics (mcg) | Activity Index |
|------------------|--------------------------------|-------------------|---------------|
|                  |                                | Aqueous Extract   | Genta | Amp | Erythro |
|                  |                                | (mg)              |       |     |         |
| *Staphylococcus aureus* | 6.67± 0.8                     | 7.56± 0.7         | 8.67± 0.9 | 20.00 | 00 | 17.00 |
| *Pseudomonas aeruginosa* | 10.00± 1                      | 12.44± 1.2        | 15.00± 1.1 | 30   | 28 | 26   |
| *Escherichia coli*   | 9.33± 1.1                     | 11.89± 1.2        | 14.33± 0.7 | 27   | 9.00 | 00   |

**Table (2):** Antibacterial activity of *Aloe Lanata* Methanolic Extract on Tested Microorganisms

| Microorganisms   | Inhibition Zones diameter [mm] | Antibiotics (mcg) | Activity Index |
|------------------|--------------------------------|-------------------|---------------|
|                  |                                | Aqueous Extract   | Genta | Amp | Erythro |
|                  |                                | (mg)              |       |     |         |
| *Staphylococcus aureus* | 6.33± 0.5                      | 7.67± 0.7         | 9.67± 0.6 | 20.00 | 00 | 17.00 |
| *Pseudomonas aeruginosa* | 10.67± 0.9                    | 11.67± 1          | 12.67± 0.7 | 30   | 28 | 26   |
| *Escherichia coli*   | 11.00± 1.2                    | 12.67± 0.7        | 12.67± 0.9 | 27   | 9.00 | 00   |

**Table (3):** Antibacterial activity of *Aloe vacillanis* Aqueous Extract on Tested Microorganisms

| Microorganisms   | Inhibition Zones diameter [mm] | Antibiotics (mcg) | Activity Index |
|------------------|--------------------------------|-------------------|---------------|
|                  |                                | Aqueous Extract   | Genta | Amp | Erythro |
|                  |                                | (mg)              |       |     |         |
| *Staphylococcus aureus* | 6.00± 0.7                      | 6.67± 0.7         | 8.00± 0.9 | 20.00 | 00 | 17.00 |
| *Pseudomonas aeruginosa* | 10.00± 0.8                    | 12.33± 1.3        | 15.00± 1.3 | 30   | 28 | 26   |
| *Escherichia coli*   | 10.33± 0.8                    | 13.00± 1          | 15.33± 0.9 | 27   | 9.00 | 00   |

**Table (4):** Antibacterial activity of *Aloe vacillanis* Methanolic Extract on Tested Microorganisms

| Microorganisms   | Inhibition Zones diameter [mm] | Antibiotics (mcg) | Activity Index |
|------------------|--------------------------------|-------------------|---------------|
|                  |                                | Aqueous Extract   | Genta | Amp (10 mcg) | Erythro (15 mcg) |
|                  |                                | (mg)              |       |              |              |
| *Staphylococcus aureus* | 6.33± 0.6                      | 6.67± 0.7         | 8.00± 0.9 | 20.00 | 00 | 17.00 |
| *Pseudomonas aeruginosa* | 10.33± 1.1                    | 11.33± 0.7        | 12.33± 1.2 | 30   | 28 | 26   |
| *Escherichia coli*   | 8.00± 0.6                      | 10.66± 0.8        | 12.33± 0.9 | 27   | 9.00 | 00 |

**Table (5):** Comparative between two Aloe aqueous extract (30 mg) and antibiotic by activity index

| Microorganisms   | Inhibition Zones diameter [mm] | Antibiotics (mcg) and activity index |
|------------------|--------------------------------|-------------------------------------|
|                  |                                | Aqueous extract (30 mg) | Antibiotics (mcg) |
|                  |                                | *A. lanata* | *A. vacill.* | Amp | Genta |
| *Staphylococcus aureus* | 8.67± 0.9                      | 8.00± 0.6 | 00 | R | 20.00 | 0.4 |
| *Pseudomonas aeruginosa* | 15.00± 1.1                    | 15.00± 1.3 | 28 | 0.54 | 30 | 0.5 |
| *Escherichia coli*   | 14.33± 0.7                    | 15.33± 0.9 | 9.00 | 1.7 | 27 | 0.57 |
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The objective of this study was to evaluate the antibacterial activity of the extracts of the medicinal plants Aloe Lanata and Aloe Vacillanis (Metholic) using a method of dilution.

The antibacterial activities of three different concentrations of extracts of the medicinal plant Aloe Lanata and Aloe Vacillanis were compared with some antibiotics (Ampicillin, Erythromycin, Gentamycin).

The results showed that the extracts of Aloe Lanata and Aloe Vacillanis were effective against the bacteria Staphylococcus aureus, E. coli, and Pseudomonas aeruginosa. The metholic extract of Aloe Lanata was more effective than the metholic extract of Aloe Vacillanis.

The results of this study can be used for the health sector in the study of medicinal plants and their extracts.