Electronic Journal of University of Aden for Basic and Applied Sciences
EJUA-BA Vol. 1 No. 1 (2020)
https://doi.org/10.47372/ejua-ba.2020.1.6
ISSN: 2708-0684

RESEARCH ARTICLE

ANTIBACTERIAL ACTIVITY OF ALOE LANATA AND ALOE VACILLANIS PLANT EXTRACTS

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Received: 16 Feb 2020 / Accepted: 28 Feb 2020 / Published online: 07 Mar 2020

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 oxytocam*, *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 grinded 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 and these were kept in a refrigerator till further use. **[8]**

2.3 Test bacterial strains

The antibacterial assay was carried out using *S. aureus, P. aeruginosa,* and *E. coli*. The organisms were obtained from the bacteriological laboratory of Al-gamhuria Hospital, Aden, Yemen.

2.4 Antimicrobial activity assay

Three bacterial strains were inoculated by spreading on the Mullar Hinton agar plates separately, after which well was punched in the plates by a sterile borer (6 mm diameter). Different concentration 50 µL (10 mg), 100 µL (20 mg) and 150 µL (30 mg) was poured into the well and plated were allowed to stand for 1 hour for samples to get diffused in media then they were incubated for 24 hours at 37°C **[9]**. The Ampicillin, Erythromycin and gentamicin sulphate was used as standard and for comparing its efficacy with extracts. When the bacteria have been grown completely on the surface of the media, then the results were determined by measuring mean of the zone of inhibition in mm produced by plant extracts and antibiotics.

Statistical analysis was carried out using Genstat version 12.

3. Result and dissection

The results showed that the antibacterial activity of plant extracts on the tested bacterial species, which are varied depending on the aloe species and concentration level of extracts as well as extract type.

The aqueous extracts of *A. lanata* are effective against all tested bacteria than their methanolic extract. The two types of extracts were investigated against all tested bacterial at (10mg, 20mg, and 30mg) concentration.

The highest activity was demonstrated by the *A. lanata* aqueous extract against *P. aeruginosa* , followed by *E. coli* and the lowest activity against *S. aureus*, the respective diameter zones of inhibition were 15 ± 1.1, 14.3 ± 0.7 and 8.67± 0.9 mm respectively by 30 mg aqueous extract concentration, Table 1. The methanolic extract was less effective against all tested bacteria than the other aqueous extract.

The methanolic extract showed higher activity on Pseudomonas *aeruginosa* 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 effected *Pseudomonas aeruginosa* 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]**:

$$\textbf{Activity Index } (AI) = \frac{\textbf{inhibition Zone of of the sample}}{\textbf{inhibition Zone of the standard}} \quad (1)$$

, 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 oxytocam*, *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

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 strong 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]					
	Aqueous Extract (mg)			Antibiotics (mcg)		
	10	20	30	*Genta*	*Amp*	*Erythro*
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]					
	Aqueous Extract (mg)			Antibiotics (mcg)		
	10	20	30	*Genta*	*Amp*	*Erythro*
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]					
	Aqueous Extract (mg)			Antibiotics (mcg)		
	10	20	30	*Genta*	*Amp*	*Erythro*
Staphylococcus aureus	6.00± 0.7	6.67± 0.7	8.00± 0.6	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]					
	Aqueous Extract (mg)			Antibiotics (mcg)		
	10	20	30	*Genta* (10 mcg)	*Amp* (10 mcg)	*Erythro* (15 mcg)
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]					
	Aqueous extract (30 mg)		Antibiotics (mcg) and activity index			
	A.lanata	*A. vacill.*	*Amp*	index	*Genta*	index
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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مقالة بحثية

الفعالية التثبيطية للمستخلصات النباتية للصبار (العندد والخرخر)

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استلم في:16 فبراير 2020 / قبل في: 28 فبراير 2020 / نشر في: 07 مارس 2020

الملخص

تقييم هذه الدراسة التأثير التثبطي البكتيري للمستخلص المائي والكحولي (Metholic) لنباتي العندد والخرخر (*Aloe Lanata, Aloe Vacillanis*). باستخدام طريقة الانتشار بالاجار تم تقدير فعالية ثلاثة تراكيز مختلفة من مستخلصات نباتي الصبار على بكتيريا (*Staphylococus aureus, E. coli, Pseudomonas aeruginosa*) وكذلك مقارنة فعالية المستخلصات ببعض المضادات الحيوية (*Ampicillin, Erythromycin, Gentamycin*). أظهرت المستخلصات فعالية متفاوتة على البكتيريا حسب نوع وتركيز المستخلص للنبات وكذلك الاستجابة التثبيطية لنوع البكتيريا. تفوق المستخلص المائي والكحولي لنبات العندد (*A.lanata*) على مستخلص نبات الخرخر (*A. vacillanis*). وبالمقارنة لنوع المستخلص كان المستخلص الكحولي نبات العندد أكثر فعالية من المستخلص المائي، في حين اظهر المستخلص المائي لنبات الخرر فعالية اعلى من المستخلص الكحولي لنفس النبات. أظهرت المستخلصات فعالية معنوية على نوعي (*E. coli, Pseudomonas aeroginosa*) وكانت اقل فعالية على بكتيريا (*Staphylococus aureus*). بالمقارنة بين الفعالية التثبيطية للمستخلصات النباتات المدروسة والمضادات الحيوية، أظهرت المستخلصات المائية والكحولية فعالية أفضل من المضاد الحيوي (*Ampicillin, Erythromycin*) على بكتيريا (*Staphylococus aureus, E. coli*).

الكلمات الرئيسية: نبات العندد، نبات الخرخر، الفعالية التثبيطية، مضادات حيوية، بكتيريا.