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Antimicrobial Activity of *Salvia officinalis* L Aqueous and Ethanolic Extracts Against *Escherichia coli*

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Abstract

The aim of this study, to evaluate the antibacterial activity of *Salvia officinalis* L., crude extract against *Escherichia coli*. The antibacterial efficacy of *Salvia officinalis* extracts was determined via the agar well diffusion method in current investigation. The results show that the aqueous and ethanol extracts had high inhibitory activity against *E. coli* at high concentrations 100% with a diameter inhibition zone of (15mm) at the same, compared to tested antibiotics (Erythromycin) which give (11mm) inhibition zone. In conclusion, the antibacterial activity of extracts of *S. officinalis* suggested that this plant represented a natural source of bioactive molecules with very important biological activity.

Keywords: Antibacterial activity; *Salvia officinalis;* Ethanol extract; aqueous extract; *Escherichia coli*.

Introduction

Medicinal plants continue to play animated role as therapeutic agents in primary and secondary health care in developing countries(Ahmed *et al.,* 2022). A number of naturally occurring compounds (such as alkaloids, phenols and flavonoids) have been shown to possess antimicrobial activities against many pathogens (Ahmed et al., 2020). Phytochemicals produced in the plant's secondary metabolism have been found to have antibacterial characteristics, which have been used to treat a variety of bacteria (Kowalczyk *et al*., 2020). Secondary metabolites found in plants exhibit antibacterial activities when tested in vitro (Leylaie and Zafari, 2018).

The genus Salvia commonly called sage is the largest member of lamiaceae or mint family containing over 900 species throughout the worl (Hamidpour *et al.,* 2013; Mohamed and Mustafa, 2019). *Salvia officinalis* L.(Sage) is an important medicinal and aromatic plant due to its bioactive components, by-products of its metabolism, it is a very popular plant in the traditional pharmacopeia of the north region (Africa) for the treatment of various pathologies(Bahr and Ibrahim, 2015). Sage tea has been traditionally used for the treatment of digestive and circulation disturbances bronchitis, cough, asthma, angina, mouth and throat information, depression, excessive sweating skin diseases, and many other diseases(Mohamed and Mustafa, 2019). According to current findings, *Escherichia coli* are not only multidrug-resistant pathogens (Strateva and Yordanov, 2009), but also pan drug-resistant and broad-spectrum drug-resistant bacteria (Magiorakos, *et al*., 2012).The treatment of complex diseases requires the development of synthetic drugs. These products can cure various pathologies and cause adverse effects on human health with a more or less severe intensity (Nisar *et al*., 2017).

To determine this growing threat, research is focusing on medicinal plants as the main resource for the therapeutic bioactive compound in addition to their use in health care by approximately 80% of the world's population(Oliveira *et al*., 2013). In fact, they are sources of biologically active compounds; phenolic compounds with antioxidant properties and antimicrobial potentials (Kaneria *et al*., 2012). The objective of this study, to evaluate the antibacterial activity of *Salvia officinalis*., crude extracts against *Escherichia coli* bacteria.

Material and methods

1.Collection of plant

The aerial parts of sage(*Saliva officinalis* L)were collected during July, 2024from Jalo, South East Libya. The plant was taxonomically identified by Dr. Ahmed Ali Mustafa, Department of Botany and Microbiology, Faculty of Science, University of Gezira, Wad-Madani, Sudan. Aerial parts materials were air dried at room temperature (35± 2°C), for one week. There after, they were finely grounded using a laboratory grinding mill (Model ED-5) just before extraction.

2.Preparation of extracts

A direct cold extraction procedure of the prepared powder material was developed, based on phytomedicine extraction program (Eloff, 1998) using ethanol and water. Accordingly, 500 grams of leaves were weighed after drying, and ground in pistil and mortar. The leaves were extracted with 1000 ml of ethanol and water, respectively, using a shaker for overnight at room temperature. The filtrate was concentrated in a rotary evaporator, and kept for further analysis and bioassay.

3.Antimicrobial activity

Biological activities of crude aerial part extracts of *Saliva officinalis.,* were evaluated against some pathogenic bacteria under laboratory conditions (av. 53ºC, and 35% R.H.). Tests were done using disc diffusion method (Bassily *et al*., 1980). According to this technique, micro-glass fiber discs of 0.5 in diameter were saturated with 20 µl/ disc crude extract diluted to a ratio of 1:2 using methanol, which was used as solvent control. , and placed on the middle of Petri-plates separately. The test organism Gram negative bacteria, viz. *Escherichia coli* (ATCC 25922) was streaked on each test Petri-plate prior to the placement of the saturated disc on mid-plate. Treated plates (three replicas for each test) were incubated at room temperature. Zones of inhibition were determined at 24 hr post-treatment.

4.Statistical analysis

Data are expressed as the mean ± Standard Deviation (M±SD). Statistical analyses of all assay results were performed using Microsoft Excel (2016).

Results and discussion

The aqueous and ethanolic extract from *S. officinalis* aerial part extracts at a concentration of 100 mg/ml demonstrated notable antimicrobial activity against *Escherichia coli* bacteria, with inhibition zones ranging from (9 to 15 mm), as detailed in Table 1. This observation suggests that the extract effectively inhibited the growth of bacteria, although the degree of sensitivity varied. The findings demonstrated that *Escherichia coli* bacteria was susceptible. The percentage activity (PA) of the plant extract evaluated indicates its comprehensive antimicrobial efficacy, reflecting the range of bacteria it can influence. Notably, the aqueous and ethanolic crude extract derived from *S.officinalis*aerial parts exhibited significant effectiveness. According to (Qaysi and Al-Tulaibawi, 2022) the extracts of *Salvia officinalis L*. give positive test for phenols which are evaluate as antimicrobial activities, antibacterial, fungistatic and virustatic.

These findings are consistent with the study by Bouteldja *et al.*(2021), who reported that the antibacterial activity of *S. officinalis* methanolic extract demonstrated a strong ability to inhibit *E.coli.* Similarly, in a study conducted by (Al-Qaysi and Al-Tulaibawi , 2022) the primary distinction lies in the presence of lipoproteins and lipo-polysaccharides in gram-negative bacteria, which act as a barrier to hydrophobic compounds. Gram-positive microorganisms do not have these components.

Comparison to tested antibiotics (Erythromycin), the tested extracts at concentration 100% give better inhibition zone than Erythromycin which give (11mm) inhibition zone at same dose shown in Table 1.Moreover,from the results sensitive Gram negative *E.coli*. Conforming results already reported (Bonsic *et al.,* 2006; Ebd-Elmageed and Hussein, 2008). Several studies had demonstrated the antibacterial activity of essential oil of leaves and aqueous extract of sage against and Gram- ve bacteria.

Table 1. Different concentration of *S. officinalis* extracts on *E.coli*

Botanical name	Extracts	concentration			
		25	50	75	100
S. officinalis	Aqueous	10±0.0	10±0.2	11±0.00	15±0.00
	Ethanol	10±0.0	9±0.00	10±0.03	15±0.04
SD	Erythromycin	NT	NT	NT	11±0.00
	Ciprofloxaci	NT	NT	NT	10±0.01

Key: NA: not tested.

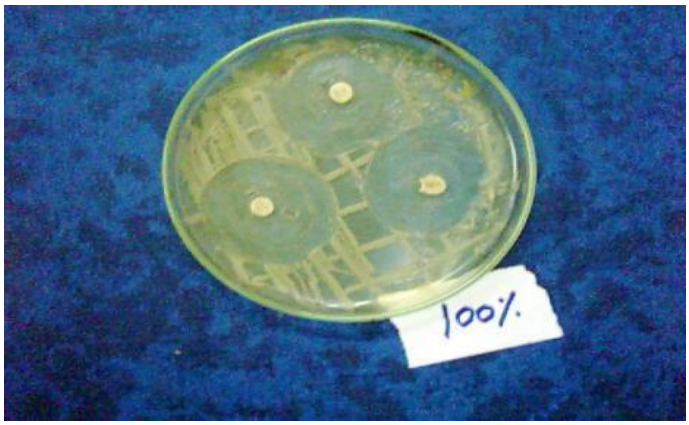

Figure 1. 1nhibition zone of *S. officinalis* extracts on *E.coli*

Conclusion

In conclusion, we have evaluated the antimicrobial activity of *S.officinalis* aerial parts. The extract demonstrated moderate suggesting a potential protective role. Future research should focus on isolating and characterizing antimicrobial and antioxidant compounds as well as conducting *in vivo* studies.

Recommendation

More research is needed to determine the efficacy of this medicinal plant against additional microorganisms in various agro-ecological environments. Additional further studies towards isolation of the active compounds will be more efficient for application.

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