

Prospects for using *Origanum Syriacum* (L.) as a source of antimicrobial agents

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ABSTRACT

Origanum syriacum (*O. syriacum*) (L.) belongs to Group B of the genus *Origanum* from (*Lamiaceae*), which is rich in essential oils that exhibit antimicrobial efficacy, anti-inflammatory efficacy, antioxidant activity, and antitumor efficacy. These processing activities are because of its richness in carvacrol and Thymol. In this article, we will focus on *O. syriacum*, discussing the antimicrobial efficacy for its essential oil and extracts, in addition, cast light on mechanism of essential oil antimicrobial action. This study was conducted from March 2019 to February 2021. We have analyzed the results of studies on antimicrobial efficacy of a plant *O. syriacum* in the PubMed, Google Scholar, Elsevier over the past 15 years using keywords. *O. syriacum* essential oil and its extracts have an extensive antimicrobial efficacy give it a great importance in pharmaceutical and medical purposes.

Key words: Antimicrobial effectiveness, carvacrol, essential oils, *Origanum Syriacum* (L.), thymol

INTRODUCTION

Antibiotic resistance is one of the most difficult problems facing the world today; there is currently a shortage of effective antibiotics, which requires the development of new antibiotics and to search for alternative solutions.^[1,2] The efficacy of thousands of plants against bacteria has known since ancient times. However, few extracts have been studied on humans and animals to ensure their safety and effectiveness.^[3] This study sheds light on *Origanum syriacum* (*Lamiaceae*) plant belongs to Group B of the

genus *Origanum* grows in the Mediterranean region.^[4-6] Estimated plant height 30–90 cm, leaves ovate, acute or obtuse, the veins are visible at the bottom surface of the leaf, the leaves are covered with glandular popper, Corolla white, the plant blooms in spring.^[7] *O. syriacum* is used in alternative medicine for processing respiratory diseases: a cough remedy, antispasmodic, carminative, painkiller, anthelmintic, treat respiratory infections, and other bacterial, fungal, and viral diseases.^[8,9] Recent studies have also proven its antioxidant effect, anticancer, antibacterial, antifungal, and anti-acetylcholine oxidant.^[3,10-18] Efficacy against colon cancer and breast cancer was also confirmed.^[19] These medicinal properties are because of its richness in carvacrol (it can be up to 79.8% from the content of essential oils) and Thymol (it can be up to 83, 8%).^[20] Moreover, 11 flavonoids were detected in the plant. Many studies recently have confirmed its antibacterial effectiveness.^[21] We found that most of the studies were done on essential oil, and very few were on alcoholic extracts, we will present the types of bacteria fungicide and viruses that *O. syriacum* has shown

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to be effective against them, with mention of the plant's parts used in these studies and focus on the mechanism of essential oil antimicrobial action.

MATERIALS AND METHODS

We have analyzed the results of microbial laboratory studies on antimicrobial efficacy of a plant *O. syriacum* in the PubMed database, Google Scholar and Elsevier over the past 10 years using keywords (*O. syriacum* (L.), essential oils, *O. syriacum* antimicrobial activity, *Origanum*, *Origanum* antibacterial activity) and also studied the literature data for the last 15 on the uses of the plant in folk medicine. This study was conducted from March 2019 to February 2021.

RESULTS

Antibacterial activity

The antimicrobial efficacy of the essential oils is caused by phenolic and monoterpene components, the most important of them are carvacrol and thymol and carvacrol has been reported to be one of the most effective antimicrobials.^[22,23] The antimicrobial efficacy of these oils is because of their hydrophobic structure and chemical composition, as hydrophobic properties facilitate the penetration of these substances into the bacterial cell membrane, which leads to a change in the arrangement of lipids and the cytoplasmic membrane, it leads to a change in the cell membrane, which, in turn, leads to alter in the chemical and physical properties of the cell membrane, an increasing of proton passive flux across the cell membrane, electron flow in the cell, active transport, and coagulation in the cell contents.^[23-25] Importance of hydroxyl group and its effective role in the antimicrobial activity return to these two compounds was also proved.^[26] A delocalized electron system allowing hydroxyl group to release proton.^[18] Moreover, many studies confirmed the synergistic effect between essential oil components.^[24,27] *O. syriacum* effects on many kinds of Gram-positive and Gram-negative bacteria, most of the studies were done on essential oil and very few studies used alcoholic extracts.^[28,29] Table 1 shows the types of bacteria that *O. syriacum* proved to be effective on them, the plant part that was used in the study, the extract or the essential oil.

Antifungal activity

O. syriacum essential oil is used in traditional medicine to treat skin fungus.^[35] Its essential oil and ethanol extracts showed efficacy against a large number of fungi^[12,14,36,37] [Table 2]. Several studies confirmed that the cytotoxic nature of essential oils is due to their lipophilic nature that enables them to penetrate the cell wall and cell membrane. Membranes damage mitochondria ceased the formation of acetyl-CoA, which leads to inhibition of aflatoxin biosynthesis and coagulate the cytoplasm, thus

Table 1: Antibacterial activity, *origanum syriacum*, with activity against many types of bacteria

Bacteria	Parts	Extract or oil	Reference
<i>B. brevis</i>	Leaves	Essential oil	[28]
<i>L. innocua</i>	Entire plant	Essential oil	[29]
<i>E. faecalis</i>	Leaves	Essential oil	[28]
	Entire plants	Essential oil	[29]
<i>M. smegmatis</i>	Leaves	Essential oil	[30]
	Aerial parts	Essential oil	[30]
<i>M. luteus</i>	Leaves	Essential oil	[28]
<i>B. subtilis</i>	Leaves	Essential oil	[28]
<i>B. megaterium</i>	Leaves	Essential oil	[28]
<i>S. aureus</i>	Entire plants	Essential oil	[29]
	Aerial parts	Essential oil	[30]
	-	Essential oil	[14]
<i>P. aeruginosa</i>	-	Ethanol extracts 70%	[31]
	Leaves	Essential oil	[28]
	Entire plants	Essential oil	[29]
<i>E. coli</i>	Arial parts	Essential Oil	[30]
	-	Ethanol extracts 70%	[22]
	Leaves	Essential Oil	[28]
	Entire plants	Essential oil	[29]
<i>E. coli</i>	Arial parts	Essential oil, hexane extracts.	[30]
	-	Ethanol extracts	[32]
	-	Ethanol extracts 70%	[31]
<i>K. oxytoca</i>	Entire plants	Essential oil	[29]
<i>Y. enterocolitica</i>	Entire plants	Essential oil	[29]
<i>B. melitensis</i>	Arial parts	Essential oil	[33]
<i>Y. enterocolitica</i> O9	Arial parts	Essential oil	[34]
<i>E. coli</i> O157:H7	Arial parts	Essential oil	[34]
<i>K. pneumonia</i>	Leaves	Essential oil	[28]
	Arial parts	Essential oil	[34]
	-	Ethanol extracts 70%	[31]
<i>S. pneumonia</i>	Arial parts	Essential oil, hexane extracts, dichloromethane	[30]
	-	Essential oil	[14]
<i>M. catarrhalis</i>	Arial parts	Essential oil	[30]
<i>B. cereus</i>	Arial parts	Essential oil, hexane extracts, dichloromethane	[30]

Contd...

Table 1: Contd...

Bacteria	Parts	Extract or oil	Reference
<i>A. lwoffii</i>	Arial parts	Essential oil, hexane extracts, dichloromethane	[30]
<i>E. aerogenes</i>	Arial parts	Essential oil	[30]
<i>P. mirabilis</i>	Arial parts	Essential oil	[30]
<i>C. perfringens</i>	Arial parts	Essential oil, hexane extracts, dichloromethane	[30]
<i>S. typhi</i>	-	Ethanol extracts 70%	[31]
<i>P. vulgaris</i>	-	Ethanol extracts 70%	[31]
<i>P. acnes</i>	Leaves	Methanol extracts	[34]

B. brevis: *Bacillus brevis*, *L. innocua*: *Listeria innocua*, *E. faecalis*: *Enterococcus faecalis*, *M. smegmatis*: *Mycobacterium smegmatis*, *M. luteus*: *Micrococcus luteus*, *B. subtilis*: *Bacillus subtilis*, *B. megaterium*: *Bacillus megaterium*, *S. aureus*: *Staphylococcus aureus*, *P. aeruginosa*: *Pseudomonas aeruginosa*, *E. coli*: *Escherichia coli*, *K. oxytoca*: *Klebsiella oxytoca*, *Y. enterocolitica*: *Yersinia enterocolitica*, *B. melitensis*: *Brucella melitensis*, *K. pneumonia*: *Klebsiella pneumonia*, *S. pneumonia*: *Streptococcus pneumonia*, *M. catarrhalis*: *Moraxella catarrhalis*, *B. cereus*: *Bacillus cereus*, *A. lwoffii*: *Acinetobacter lwoffii*, *E. aerogenes*: *Enterobacter aerogenes*, *P. mirabilis*: *Proteus mirabilis*, *C. perfringens*: *Clostridium perfringens*, *S. typhi*: *Salmonella typhi*, *P. vulgaris*: *Proteus vulgaris*, *P. acnes*: *Propionibacterium acnes*

Table 2: The essential oils and ethanol extracts from *origanum syriacum* showed efficacy against many types of fungi

Fug	Part	Oil/extract	Reference
<i>A. niger</i>	Leaves	Essential oil	[36]
	Leaves	Ethanol extracts	[37]
<i>A. flavus</i>	-	Essential oil	[12]
<i>A. fumigates</i>			
<i>F. oxysporum</i>	Leaves	Essential oil	[36]
<i>Penicillium</i> species	Leaves	Essential oil	[36]
	Leaves	Ethanol extracts	[37]
<i>C. albicans</i>	Leaves	Ethanol extracts	[37]
<i>S. cerevisiae</i>	Leaves	Ethanol extract	[37]
	Leaves	Essential oil	[12]

A. niger: *Aspergillus niger*, *A. flavus*: *Aspergillus flavus*, *A. fumigates*: *Aspergillus fumigatus*, *F. oxysporum*: *Fusarium oxysporum*, *C. albicans*: *Candida albicans*, *S. cerevisiae*: *Saccharomyces cerevisiae*

damage to the cellular organelles and they also strongly negatively affect the membrane by interacting with cellular ions or active sites of enzymes that depleting the ATP pool.^[38,39] Effect mechanism that essential oil works on fungal strains appears to be similar to the way it works against bacteria where the treatment of *A. flavus* fungus with *Mentha entate* essential oil led to leakage calcium, magnesium, and potassium ions, the occurrence of damaged fungal cell structure and reduced ergosterol content of the cell membrane has a strong role in maintaining the durability of the fungal cell membrane.^[40]

Antiviral activity

O. syriacum has been used against colds and influenza since

ancient times. However, evidence and studies proving its anti-viral effectiveness are still scarce.^[41] *O. syriacum* essential oils showed anti-herpes effectiveness against Type I.^[42] In other studies, ethanol extracts of *O. syriacum* showed anti-HSV-1.^[43]

DISCUSSION

Many studies have confirmed that most antibiotics, especially aminoglycosides, have efficacy against many bacteria *in vitro*, and they are not effective against the intracellular pathogens, Activity of thymol on *Salmonella typhimurium* has explained *in vivo* because thymol action fights bacteria is through crossing the cell membrane.^[22,23,26] Thymol is able to protect macrophages from death due to oxidative stress.^[26] Thymol and carvacrol act in various roles against many bacteria species, thymol more toxic against *Staphylococcus aureus* than carvacol, but carvacrol is the most toxic against *Escherichia coli*.^[23] It is important to remember that there are two types of the plant: one contains mainly carvacrol whereas the other contains mainly thymol.^[44] Studies have confirmed the importance of harvest time, type of soil, and the effect of climate on the quantity and quality of the essential oil^[45,46]

CONCLUSION

We can suggest that *O. syriacum* essential oil and its extracts have an extensive antimicrobial efficacy give it a great importance in pharmaceutical and medical purposes.

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Conflicts of interest

There are no conflicts of interest.

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