Impact of Antibiotic Interactions with Essential Oils on Bacterial growth

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Abstract

Background and aim: Many bacteria have evolved resistance to conventional antibiotics as a result of their widespread usage. This means that to treat an illness, new antibiotics must be created regularly. Increased Diseases have historically employed essential oils (EOs) to treat or cure infectious infections, despite antibiotic resistance. Many of these essential oils have been tested for antibacterial action in the laboratory, and a considerable number of EOs compounds have been found to suppress the development of bacterial spores. This work is carried out to see if essential oils can have a therapeutic function on bacterial growth. **Materials and methods:** Several bacterial samples were resistant to various antibiotics. The specimens were collected and transferred under aseptic circumstances to the Microbiology Laboratory. A sterile loop was used to collect the clinical samples, which was then placed into a transportable media. The materials were gathered in an aseptic environment. The disc diffusion method was used to test antibiotic susceptibility with EOs. **Result:** The bacteria *E. coli*, *Streptococcus* sp., *Pseudomonas* sp., and *Klebsiella* sp. were all found. When their antibacterial powers were tested against EOs, cinnamon and arugula oils were shown to be rich sources of essential oils with diverse antibacterial activities. **Conclusion:** These essential oils appear to have structures and mechanisms of action that inhibit bacterial growth.

Keywords: Essential Oils, bacteria, Antibiotics, Growth

1. Introduction:

The battle between humans and a plethora of illnesses and disease-causing disorders has raged for generations. Bacterial resistance and its fast increase are emerging on the battlefield as one of the most serious threats to human health [1]. Many bacteria have evolved resistance to conventional antibiotics as a result of their misuse. This means that to treat an illness, new antibiotics must be created regularly. However, new resistance appears to be arising practically simultaneously [2].

Many experts believe that treating infectious illnesses will become increasingly challenging. Antibiotics are widely used for purposes other than medicine, which adds to the rise in antibiotic resistance. Antibiotic usage in animal husbandry is a good illustration of this. Only by implementing

more reasonable antibiotic usage through treatment recommendations can these detrimental tendencies be reversed [3].

Antibiotic-producing bacteria must be resistant to the antibiotics they generate, or else they will die. Antibiotic resistance can develop in other bacteria if they are exposed to antibiotics for lengthy periods or at doses that are insufficient to kill bacteria promptly [4]. Furthermore, existing antimicrobial medicines are quickly losing effectiveness, shifting the balance in favor of multidrug-resistant organisms, and there appear to be few if any, new medication classes under clinical development [5]. There has never been a greater need for research into the creation of new antibiotics. In the last decade, advances in research methods and microbial genome sequencing have resulted in the discovery of a huge number of novel targets [6].

Traditional healers have traditionally employed EOs to prevent or treat infectious diseases in the era of new and re-emerging infectious diseases, as well as increasing antibiotic resistance [7]. Many of these essential oils have been studied for antimicrobial action, and a vast number of EOs compounds have been found to suppress the development of harmful bacteria [8]. Most previous research on essential oils is missing in Egypt, and there is no active search for the herbal treatment. As a result, we devised this research to identify bacteria and give insight on the usefulness of employing essential oils from several Egyptian native medicinal plants in the therapy.

As a result, a number of these EOs appear to have structures and modes of action that differ from those of currently used antibiotics, indicating that cross-resistance with currently used antibiotics may be negligible. As a result, investigating EOs for antimicrobial action is beneficial.

2. Materials and Methods

Obtaining and processing samples:

This work looked at several bacterial samples that were resistant to various antibiotics. The samples came from a variety of clinical laboratories. The work was carried out from November 2020 to July 2021. The specimens were collected and transferred under aseptic circumstances to the Microbiology Laboratory at the Botany and Microbiology Department, Faculty of Science, Benha University, where the study was conducted according to Bruneau et al., 2001 [9].

Isolation and culture of bacteria:

A sterile loop was used to collect the clinical samples, which were then placed into a transportable media. The materials were gathered in an aseptic environment.

Antibiotic Susceptibility:

The disc diffusion method was used to test antibiotic susceptibility for the following antibiotics (Biomed, Egypt): Vancomycin (VA 30 mg), Ciprofloxacin (CIP 20 mg), and Gentamicin (GEN 20 mg). The findings were calculated using the Clinical and Laboratory Standards Institute's (CLSI) recommendations [10].

Essential oils that were tested:

After the experiment was completed, five essential oils were chosen to conduct the antimicrobial susceptibility test. The following were used to represent essential oil names:-

Table 1: Essential oils used in the study

English name	Scientific name	Family name	Properties
Cinnamon Oil	*Cinnamomum zeylanicum*	Lauraceae	Carminative, stomachic, astringent, stimulant and Antiseptic.
Rosemary Oil	*Rosmarinus officinalis*	Labiatae	Carminative, stimulant and flavouring agent.
Thyme Oil	*Thymus vulgaris*	Labiatae	carminative, antipyretic, antiviral,
Garlic Oil	*Allium sativum*	Amaryllidaceous	Boost the function of the immune system.
Arugula	*Eruca sativa*	Brassicaceae	Cancer-fighting agents.

3. Results

Antibacterial activity of several essential oils were tested.

The antibacterial activity of five Egyptian EOs was studied against the isolated bacteria, with the results presented in Table 1-3. Garlic Oil, Arugula, Rosemary, Thyme, and Cinnamon were selected for carrying out the antimicrobial susceptibility test together with various antibiotics against all tested bacterial species.

Table 2: Antimicrobial activity of different essential oils on the isolated bacteria vs. Vancomycin antibiotic.

Bacteria / **EOs**	***E. coli***	***Strep. Pyogen***	***Pseudomonas sp.***	***Klebsiella sp.***
Control	27	18	_____	_____
Garlic Oil	28	17	_____	_____
Arugula	32	16	_____	_____
Rosemary	29	22	_____	_____
Thyme	31	18	_____	_____
Cinnamon	30	19	_____	_____

Table 3: Antimicrobial activity of different essential oils on the isolated bacteria vs. Ciprofloxacin antibiotic.

Bacteria ESO	E. coli	Strep. Pyogen	Pseudomonas sp.	Klebsiella sp.
Control	23	24	21	28
Garlic Oil	26	23	20	29
Arugula	24	24	23	28
Rosemary	23	25	18	31
Thyme	21	22	19	33
Cinnamon	26	23	22	25

Table 4: Antimicrobial activity of different essential oils on the isolated bacteria vs. Gentamycin antibiotic.

Bacteria ESO	E. coli	Strep. Pyogen	Pseudomonas sp.	Klebsiella sp.
Control	15	13	10	21
Garlic Oil	16	15	14	14
Arugula	17	16	21	18
Rosemary	14	15	19	_____
Thyme	19	17	22	15
Cinnamon	24	22	24	13

4. Discussion

Antibiotic resistance is a global problem, but due to a lack of good surveillance, some countries are unaware of it. Public health officials have produced documents describing action plans to combat antibiotic resistance, as well as incentives for pharmaceutical corporations to engage in antibiotic research, due to a decrease in antibiotic development and an increase in reports of resistance.

In our analysis, both *Pseudomonas* and *Klebsiella* were resistant to at least five EOs, as shown in the preceding tables. *Klebsiella* has been shown to be resistant to Vancomycin medicines. Our findings back with a previous study by Lee et al, which found that *Klebsiella* and pseudomonas were vancomycin resistant [11].

Regardless, all of the EOs were effective against the other two isolates. This is in accordance with the findings of Inouye et al, who discovered that using a modified dilution test approach, screening of the antibacterial effects of a range of essential oils on respiratory tract pathogens was efficient against *E.coli* [12].

When coupled with ciprofloxacin and gentamycin, five essential oils, including garlic oil, arugula, rosemary, thyme, and cinnamon, were found to be effective against *E.coli* and *streptococcus pyogen*. In *E.coli*, the inhibition zones of eight oils were 23, 26, 24, 23, 21, 26 mm, while in *Streptococcus pyogen*, the inhibition zones were 24, 23, 24, 25, 22 mm. These findings matched those of Abubakar [13], who discovered that crude garlic extracts are more effective against *Escherichia coli*, *Streptococcus* Spp., and *Pseudomonas aeruginosa*.

The antibacterial activity of essential oils on isolated bacteria compared to the drug Gentamycin indicated that *Klebsiella* was resistant to rosemary. *E. coli*, on the other hand, had the highest inhibitory zones in Arugula. Gentamycin, in conjunction with the five essential oils, inhibited the growth of four bacteria identified. In *Pseudomonas* and *E.coli*, cinnamon oil created the biggest inhibitory zone [14].

As a result, the order of antibiotics and essential oils may be ciprofloxacin > gentamycin > vancomycin. Cinnamon oil has the greatest antibacterial effects of all of the essential oils examined. Essential oils are commonly utilized to treat a wide range of conditions, including skin infectious diseases [15]. It's also a key ingredient in a number of topical treatments for dandruff, acne, lice, herpes, and other skin issues [16].

5. Conclusion

The results of this examination revealed that *E. coli*, *Streptococcus* sp., *Pseudomonas* sp., and *Klebsiella* sp. were all isolated. Cinnamon and arugula oils were shown to be rich sources of essential oils with multiple antibacterial effects when their antibacterial capabilities were evaluated against isolated microorganisms.

Authorship contributions:

Participated in research design: AE, AAA. **Conducted experiments**: JGE, AAA. **Performed data analysis**: AE. **Wrote or contributed to writing of the manuscript**: All authors.

Conflict of interest

There are no conflicts of interest declared by the authors.

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Data and materials availability

The article contains all of the data related to this investigation.

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