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Investigation antibacterial effect of euphorbia plant against different types of bacteria

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Abstract

In the present study, antibacterial activity assays were conducted using the extract of *Euphorbia lucida* Waldst. & Kit. against a range of bacterial strains. The efficacy of different dosage of the plant extract against different bacterial species was evaluated employing the disk diffusion method. The tested microorganisms included *Klebsiella pneumoniae*, *Pseudomonas fluorescens*, *Salmonella kentucky, Listeria innocua, Serratia marcescens, Staphylococcus aureus, Bacillus subtilis, and Escherichia coli*. The results demonstrated that *Euphorbia lucida* Waldst. & Kit extract exhibits notable antibacterial activity, with the most pronounced inhibitory effects observed against *Bacillus subtilis* (29.35 mm) and *Klebsiella pneumoniae* (24.95 mm). These findings suggest the potential utility of Euphorbia-derived compounds in both medical and environmental disinfection applications.

Keywords: Antibacterial test; Bacterium; Disinfection; Euphorbia plant

1. Introduction

Disinfection refers to the systematic process of eliminating or neutralizing pathogenic microorganisms to inhibit the transmission of infectious diseases and sustain hygienic standards in both personal and communal environments [1]. Particularly in the post-pandemic period, the critical role of effective disinfection practices has intensified significantly within individual and societal contexts. The rapid proliferation of pathogenic microorganisms on various surfaces, equipment, and water systems necessitates the deployment of robust and safe disinfection methods [2]. Historically, heavy metals such as silver and zinc have been extensively studied and utilized for their antibacterial properties; however, the utilization of these metals has raised concerns regarding environmental pollution, toxicity, and potential health risks from direct human contact [3]. Furthermore, the inadvertent release of such metallic compounds into ecosystems has been linked to substantial ecological harm, affecting both aquatic and terrestrial organisms adversely [4]. Recent studies show that some of the heavy metals pose a threat to human health even at very low concentrations [5-13], and even those necessary for living things can be harmful at high concentrations [14-19]. Therefore, it is recommended to reduce the release of heavy metals into nature and even to carry out studies to reduce their concentrations in nature [20-27]. Consequently, there is an escalating demand for exploring novel, naturally sourced disinfectants to complement or replace conventional chemical methods, leading to increased scientific attention towards plant-based antimicrobial agents

Plants fulfill many ecological, economic and social functions in nature [28-41]. In addition, they are widely used in medicine. Medicinal plants, deeply embedded in human culture, tradition, and history, continue to grow in prominence for their therapeutic and antibacterial potentials [42]. The appeal of plant-derived disinfectants is primarily due to their natural bioactive constituents, including alkaloids, glycosides, terpenoids, saponins, steroids, flavonoids, tannins, quinones and coumarins, known for their ability to disrupt microbial cell walls or interfere with vital microbial

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metabolic pathways, thus offering potent biological defense mechanisms [43,44]. Among these medicinal plants, Euphorbia species have a notable history in traditional medicine practices, and contemporary research consistently highlights their substantial antimicrobial activities [45,46]. These studies indicate promising opportunities for employing certain Euphorbia species in natural disinfection practices.

Methanolic extracts of various Euphorbia species including *Euphorbia aleppica* L, *E. macroclada,* and *E. virgate* have demonstrated significant inhibitory effects against a range of pathogenic microorganisms. Kirbag et al. [45] reported the antimicrobial activity of methanolic extracts and latex from several Euphorbia species *(Euphorbia aleppica*, *E. szovitsii var. harputensis*, *E. falcata* etc.)used medicinally in Türkiye. Extracts from eight species were tested against various bacteria (*Staphylococcus aureus*, *Escherichia coli*, *Klebsiella pneumoniae*, *Candida albicans* etc.) and the results showed varying levels of microbial inhibition, with MIC values ranging from 31.2 to 1000 µg. Similarly, Ribinskas et al. [47] evaluated methanolic extracts of *Euphorbia helioscopia L*. against methicillin-resistant Staphylococcus aureus (MRSA) strains using the disc diffusion method demonstrating notable antibacterial effects. Euphorbia hirta has also been extensively studied for antimicrobial potential. Perumal et al. [48] assessed the antimicrobial and cytotoxic properties of different solvent extracts derived from Euphorbia hirta. Among the tested extracts, the ethanolic fraction displayed the most potent antimicrobial effect, particularly against *Salmonella typhi*. The study suggest that *E. hirta* contains bioactive compounds with significant antimicrobial potential and low cytotoxicity. These findings indicate that Euphorbia species contain bioactive compounds specifically phenolic compounds and flavonoids that contribute to their antimicrobial effectiveness. Consequently, Euphorbia species represent promising candidates for the development of plant-based disinfectants and novel antimicrobial agents.

Euphorbia lucida Waldst. & Kit. is a perennial herbaceous species belonging to the Euphorbiaceae family, commonly found in moist habitats such as river valleys, wet meadows, and forest edges. Native to regions stretching from Central Europe to Central Asia, it is also part of the natural flora of Türkiye. The plant is characterized by its glossy dark green lanceolate leaves and yellowish-green flowers. While *E. lucida* is considered rare or locally distributed in countries such as Germany and Austria, it is more widespread in parts of Eastern Europe and Türkiye. Moreover, several Euphorbia species have long been used in traditional medicine due to their bioactive compounds with reported antimicrobial, cytotoxic, and anti-inflammatory properties [49]. In this context, *Euphorbia lucida* holds potential for further phytochemical and pharmacological exploration.

In this study, the antibacterial activity of various concentrations of Euphorbia lucida extract was evaluated against different bacterial strains. Antibacterial assays were conducted using the standard disk diffusion method, and the tested organisms included *Klebsiella pneumoniae, Pseudomonas fluorescens, Salmonella kentucky, Listeria innocua, Serratia marcescens, Staphylococcus aureus, Bacillus subtilis,* and *Escherichia coli.* The aim of the study was to assess the potential of *Euphorbia lucida* as a natural antimicrobial agent and to investigate whether its efficacy varies by dose and bacterial species..

2. Material and methods

2.1. Pereparation of Euphorbia Plant Extract

Euphorbia lucida Waldst. & Kit. was collected from Bartın, Türkiye and its extract was separated. Then the extract of this plant was preserved at 4 °C.

2.2. Types of Bacteria and Paper Disc Preparation

Klebsiella pneumoniae, Pseudomonas aeruginosa (DSMZ 50071), *Salomonella kentucky, Listeria innocua, Saratia marrescens* (ATCC 13048), *Staphylococcus aureus* (ATCC 25923), *Bacillus subtilis* (DSMZ 1971) and *Escherichia coli* (ATCC 25922) were used in the study. The filter paper was perforated with a punch and placed in a glass petri dish. Then it was sterilized under 1 atm pressure at 200ºC for 2 hours.

2.3. Experimental Study

The solution to be used was obtained by adding the desired concentration of bacteria to sterile distilled water. The desired initial bacterial concentration (105 CFU/mL) was obtained by making the necessary dilution from the bacterial culture incubated overnight at 37°C the day before. Disk diffusion method was used in the study and studies were carried out at ambient temperature. Nutrient broth and nutrient agar were used for bacterium as a medium. Studies were carried out with *Euphorbia lucida* Waldst. & Kit.extract undiluted and 3 different concentrations (2%, 10%, 100%). Samples taken during the studies were incubated for 1 day at 37 °C after being planted in suitable media.

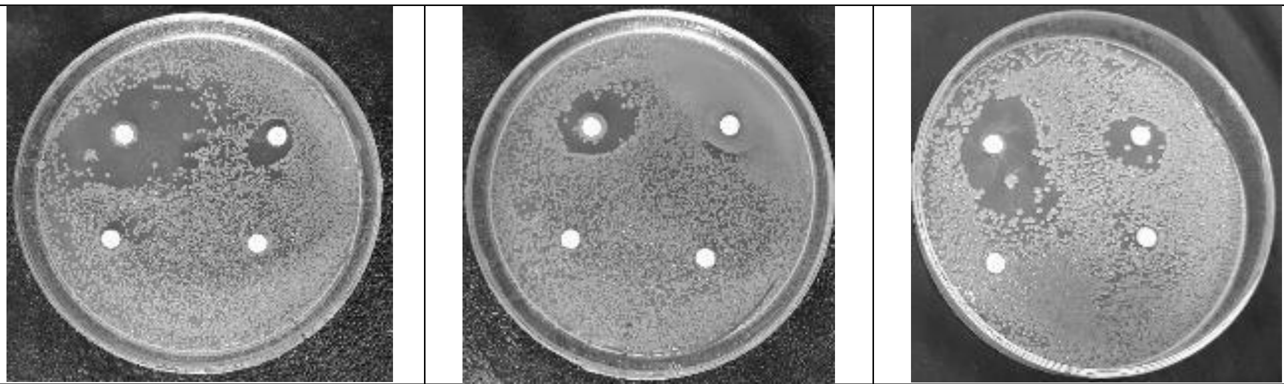
3. Results and Discussion

In the study, studies were conducted with different *Euphorbia lucida* Waldst. & Kit. extract dosages and the results are shown in Table 1. Antibacterial effect of Euphorbia lucida Waldst. & Kit. on some bacteria is shown in Fig.1. In the study, the best bacterial effect was seen in *Bacillus subtilis* and *Klebsiella pneumoniae* bacteria. This suggests that the phytochemical components present in Euphorbia may exert variable effects on both Gram-positive and Gram-negative bacteria. The strong inhibitory effect observed against *Bacillus subtilis* is likely due to the cell wall structure of this Gram-positive bacterium, which may be more susceptible to the active compounds in the extract. *Klebsiella pneumoniae* also showed considerable sensitivity to the extract. This indicates that the *Euphorbia* extract may contain bioactive compounds capable of penetrating even more resilient bacterial defenses, pointing to a promising potential for broad-spectrum application. On the other hand, relatively lower antibacterial activity was observed against *Pseudomonas fluorescens, Salmonella kentucky, Listeria innocua, Serratia marcescens, Staphylococcus aureus,* and *Escherichia coli*. These results suggest that the efficacy of the extract is strain-specific, and certain bacteria may possess intrinsic or acquired resistance to its active constituents. In particular, the lower effect observed on Pseudomonas fluorescens, a bacterium known for its environmental resilience, supports this interpretation. These findings highlight the potential of Euphorbia extract as a natural antimicrobial agent.

Table 1 Antibacterial Effect Results of Different Dilutions of Euphorbia Plant Extract

Types of Bacteria	**Undiluted (mm)**	**%2 (mm)**	**%10 (mm)**	**%100 (mm)**
Klebsiella pneumoniae(4)	24.95	17.61	6	6
Pseudomonas aeruginosa (5)	20.11	12.50	8.14	-
Salomonella kentucky(7)	11.43	-	-	-
Listeria innocua(9)	10.31	9.89	-	-
Saratia marrescens(19)	19.59	11.63	-	-
Staphylococcus aureus(15)	17.05	16.67	10.01	7.10
Bacillus subtilis	29.35	15.87	8.51	-
Escherichia coli	22.76	-	-	-

- : no zone formation



(a) (b) ©

Figure 1 Antibacterial effect of euphorbia extract on some bacteria (a) *Bacillus subtilis* (b) *Escherichia coli* (c) *Klebsiella pneumoniae*

4. Conclusion

In this study, the antibacterial effects of Euphorbia plant extract were evaluated against eight different bacterial strains. The findings revealed that the extract exhibited notably high antibacterial activity against *Bacillus subtilis* and *Klebsiella pneumoniae*. These findings suggest that Euphorbia extract exhibits strong disinfectant properties, particularly against these two bacterial species indicating the extract's potential effectiveness against both Gram-positive and some resistant Gram-negative bacteria. Limited effects were recorded against *Pseudomonas fluorescens, Salmonella kentucky,* *Listeria innocua, Serratia marcescens, Staphylococcus aureus*, and *Escherichia coli,* suggesting that the extract's efficacy varies depending on the bacterial species. Overall, this study supports the potential use of plant-derived extracts as alternative antimicrobial agents. However, further research is needed to isolate and identify the specific bioactive compounds responsible for the observed effects.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare that they no conflict of interest. The none of the authors have any competing interests in the manuscript.

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