



# Investigation of the Antibacterial Activity of Different *Pelargonium Graveolens* Essential Oils Sold in the Market

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## ABSTRACT

**Objective:** *Pelargonium graveolens* is a medicinal plant belonging to the Geraniaceae family. It is rich in essential oil. In this study, the antimicrobial activity of 5 different commercial *Pelargonium graveolens* essential oils was tested and compared.

**Methods:** The disc diffusion method was used for antimicrobial activity determination.

**Results:** Four essential oils were found to be effective against the gram-positive bacteria *Staphylococcus aureus*. One of the essential oils did not show any effect against any bacteria.

**Conclusion:** It has been observed that the essential oil of *Pelargonium graveolens* is especially effective against *Staphylococcus aureus*, and the herbal products available in the market do not show the same effect.

**Keywords:** Antimicrobial activity, essential oil, *Pelargonium graveolens*, *Staphylococcus aureus*

## INTRODUCTION

*Pelargonium graveolens* (Geraniaceae) is a medicinal species with many biological activities, containing various compounds such as terpenes, flavonoids, steroids, alkaloids, tannins, phenols, saponins, glycosides, reducing sugars, and anthraquinones.<sup>1,2</sup> It has been determined that massage and inhalation applied to the head and neck area in the morning and evening with *P. graveolens* essential oil is an effective application for reducing the perceived stress level.<sup>3</sup> *P. graveolens* has been used in traditional treatment for diseases such as hemorrhoids, dysentery, and cancer. It has some activities such as antioxidant, antibacterial, antifungal, and acaricidal. It contains a high amount of essential oil.<sup>4</sup> The main compounds were defined as citronellol, geraniol, and citronellyl formate in essential oil.<sup>5,6</sup> Moreover, kaempferol 3-O-rhamnoside-glucoside, kaempferol 3,7-di-O-glucoside, kaempferol 3-O-glucoside, quercetin 3-O-glucoside, quercetin 3-O-pentose, quercetin 3-O-rhamnoside-glucoside, quercetin 3-O-pentoside-glucoside, and myricetin 3-O-glucoside-rhamnoside flavonoids were determined in methanolic and aqueous extracts, respectively.<sup>6</sup> Increasing antibiotic resistance in hospital and community-acquired infectious agents is an important problem. Resistance observed in microorganisms such as *Escherichia coli*, *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Enterobacter* spp., *Acinetobacter* spp., *Pseudomonas aeruginosa*, *Streptococcus pneumoniae*, and *Mycobacterium tuberculosis* causes difficulties in treatment.<sup>7</sup> Antimicrobial resistance is an important problem threatening human and animal health all over the world. It is thought that new molecules waiting to be discovered in natural products will reduce the problem of antimicrobial resistance.<sup>8</sup> In this study, the antimicrobial activity of *P. graveolens* essential oils purchased from 5 different companies was investigated and compared.

## METHODS

Five different brands of *Pelargonium graveolens* essential oil (100% purity) sold in the market were provided. Samples are numbered from 1 to 5. Antibacterial efficacy of oils against *Staphylococcus aureus* ATCC 29213, *Escherichia coli* ATCC 25922, *Pseudomonas aeruginosa* ATCC 9027, *Klebsiella pneumoniae* ATCC 700603, and *Proteus mirabilis* ATCC 25933 standard bacterial strains according to the Clinical and Laboratory Standards Institute (CLSI) determined by the Kirby-Bauer diffusion method.<sup>9</sup> Ciprofloxacin 5 µg (Oxoid, USA) was used as the standard antibiotic. Bacteria stored at -80 °C before the study were cultivated in tryptic soy broth medium and incubated at 37°C for 24 hours. Then, it was passaged into a solid medium suitable for growth (eosin-methylene blue agar, 5% sheep blood

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Table 1. Essential Oils Zone Diameters

Essential Oils	Bacteria				
	<i>Escherichia coli</i> ATCC 25922	<i>Klebsiella pneumoniae</i> ATCC 700603	<i>Pseudomonas aeruginosa</i> ATCC 9027	<i>Staphylococcus aureus</i> ATCC 29213	<i>Proteus mirabilis</i> ATCC 25933
1	-	-	-	13 mm	-
2	-	-	-	-	-
3	-	-	-	13 mm	-
4	-	-	-	15 mm	-
5	-	-	-	18 mm	-
Ciprofloxacin 5 µg	34 mm	26 mm	35 mm	24 mm	40 mm

agar) and incubated at 37°C for 24-48 hours. Essential oils were absorbed into empty and sterile antibiotic discs (10 µL for each disc). 0.5 MC Farland turbidity from all bacteria for disc diffusion test suspensions was prepared and cultivated on Mueller–Hinton agar. Essential oil-impregnated discs and ciprofloxacin discs were placed on the surface of the medium. After an overnight incubation at 37°C, the diameters of the zones formed around the discs were measured. The tests were repeated 3 times, and the averages of the zone diameters were calculated.

## RESULTS

Except for the number 2 essential oil, all essential oils were found to be effective against *Staphylococcus aureus*. No effect was observed against any other bacteria. Zone diameters are shown in Table 1.

## DISCUSSION

In this study, the antimicrobial effect of 5 different commercial *Pelargonium graveolens* essential oils against *Escherichia coli*, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, *Staphylococcus aureus*, and *Proteus mirabilis* bacteria was tested by the disc diffusion method. Ciprofloxacin was used as a control. Essential oils 1, 3, 4, and 5 were effective only against *Staphylococcus aureus* (13 mm, 13 mm, 15 mm, and 18 mm zone diameter, respectively). The number 2 essential oil was not found to be effective against any bacteria. They showed higher activity against gram-positive bacteria than gram-negative bacteria.

In a previous study, the antimicrobial effect of *P. graveolens* essential oil was investigated by the disc diffusion method against *Listeria monocytogenes*, *Salmonella enteritidis*, *P. aeruginosa*, *E. coli*, *S. aureus*, and *Bacillus subtilis*. It was found to be effective against all bacteria except *L. monocytogenes*. It showed the highest effect against *S. aureus*.<sup>10</sup> Similar to these results in our study, samples 1, 3, 4, and 5 were found to be effective against *S. aureus*. Unlike in our study, no effects were observed against *P. aeruginosa* and *E. coli*. In another previous study, extracts of *P. graveolens* obtained by decoction and infusion methods showed antimicrobial activity against *S. aureus* (16 mm and 15 mm zone diameter, respectively).<sup>11</sup> In this study, most of the essential oils showed activity against *S. aureus*. Methicillin-resistant *S. aureus* has become an important problem all over the world since it was first identified in 1961. In recent years, isolates of Methicillin-resistant *S. aureus* have caused both hospital-acquired and community-acquired infections.<sup>12</sup> *S. aureus* is a pathogen frequently isolated from bloodstream infections, skin and soft tissue infections, and postoperative wound infections acquired in the hospital.<sup>13</sup> If the effect of *P. graveolens* essential oil against this bacterium is investigated with more detailed studies, it may be beneficial.

In this study, it was observed that different branded essential oils obtained from the same plant showed different effects.

Therefore, it is important that medicinal plants are standardized in terms of safety, efficacy, and quality. The plant must be correctly identified.<sup>14</sup>

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