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Short Communication

Investigation of Antibacterial Properties of *Cotinus coggygria* from Turkey

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Abstract

Today it is quite important to develop new, reliable, cost-efficient, and non-toxic herbal anti-microbial agents in order to minimize environmental and health problems. This study uses the disc diffusion method to examine the antimicrobial activity of the extracts of *Cotinus coggygria* Scop. prepared in ethanol, methanol, distilled water, chloroform, acetone, and petroleum ether against the bacteria *Staphylococcus epidermidis*, *Escherichia coli*, *Salmonella typhimurium*, *Enterococcus faecalis*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, and *Bacillus subtilis*. *Cotinus coggygria* was found to inhibit the reproduction of microorganisms at various rates. The plant extracts in distilled water and methanol were found to be the most effective against *Staphylococcus aureus*, *Staphylococcus epidermidis*, and *Enterococcus faecalis*.

Keywords: *Cotinus coggygria*, antimicrobial activity, disc diffusion method

Introduction

The examination of new antimicrobial components with various chemical characteristics and mechanisms of action has become a continuous and urgent necessity. A threatening increase was observed in the incidence of new and re-emerging infectious diseases. Another concern is the development of resistance against the range of antibiotics presently in clinical use. Multidrug-resistance of pathogenic microorganisms has made it necessary to examine new antimicrobial agents obtained from plants and other sources. Plants produce various chemical components of different biological activities, including antimicrobial components that were shown to have active effects against various pathogen microorganisms. As the effects of plant extracts differ from those of antibiotics, these extracts are expected to be effective against drug-resistant microbial pathogens [1]. *Cotinus coggygria* Scop., known locally as the smoke tree, occurs widely from southern Europe to China. *Cotinus coggygria* is in demand because of its long efflorescence and fruitage period in summer, easy culturing, and long life [2].

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Phytochemical analysis of *Cotinus coggygria* Scop. determined the following components: C-3/C-3″ dimer of butin (3′,4′,7-trihydroxyflavanone), gallic acid and its methyl ester, catechin, profisetinidins: fisetinidol-(4α→8)-(+)-catechin and epifisetinidol-(4β→8)-(+)-catechin; flavanonols: fustin and dihydroquercetagetin; flavanones: butin and eriodictyol; flavonols: fisetin and quercetin; and chalcone butein and aurone sulfuretin [3]. The present study determined the antibacterial activity of *Cotinus coggygria* extracts prepared with various solvents. Therefore, the medical characteristics of *Cotinus coggygria*, which grows naturally in Turkey, were determined in line with the purpose of contributing to future studies.

Experimental Procedures

Cotinus coggygria used in the study was obtained from Yalova, Turkey. *Cotinus coggygria* belongs to the family Anacardiaceae [4]. Test microorganisms used in the study were *Staphylococcus epidermidis* ATCC 12228, *Escherichia coli* ATCC 25922, *Salmonella typhimurium* ATCC 14028, *Enterococcus faecalis* ATCC 29212,

Pseudomonas aeruginosa ATCC 9027, *Staphylococcus aureus* ATCC 29213, and *Bacillus subtilis* ATCC 6633, which were obtained from Istanbul University and Gebze High Technology Institute.

Shadow dried *Cotinus coggygria* leaves were ground to a powder in sterile conditions. Two grams of powder were placed in the soxhlet device, with 150 ml of chemical solvent, and subjected to 24 hours of extraction. Ethanol, methanol, distilled water, chloroform, acetone, and petroleum ether were used as solvents. The solvents in the obtained extracts were removed using a rotary evaporator. Bacteria strains were inoculated to Tryptic Soy Broth medium, and were then activated by incubating at 37ºC for 24 hours. Bacteria density was adjusted to 0.5 MacFarland at the end of the incubation. The disc diffusion method was used to determine the antibacterial activity. The extract concentrations (1,600/30 µl, 800/30 µl, 400/30 µl, and 200/30 µl) were obtained by adding each extract as its own solvent at the determined rates. The sterile 6 mm discs were left to dry after being saturated by the prepared 30 µl extracts. For each extract, its own solvent was used as a negative control. Standard commercially available antibiotic discs Gentamicin and Ceftriaxone were used as positive controls. The prepared Mueller Hinton Agar media were inoculated with a density-adjusted bacterial suspension. The discs were slightly pushed onto the Agar. Petri boxes prepared in this way were incubated at 37ºC for 24 hours. Inhibition zone diameters were measured at the end of incubation.

Results

The results of the study are shown in Table 1. *Cotinus coggygria* was found to inhibit the reproduction of microorganisms at different rates. The plant extract in the distilled water was found to be the most effective against *Enterococcus faecalis*, with an inhibition diameter of 20 mm. According to the data obtained, the extracts of *Cotinus coggygria* in distilled water and methanol were observed to be most effective against *Staphylococcus aureus*, *Staphylococcus epidermidis*, and *Enterococcus faecalis*.

Discussion and Conclusion

In the study of Novaković et al. [5], essential oils obtained via hydrodistillation of the young branches and leaves of *Cotinus coggygria* were analyzed via GC-MS, which identified 31 components, including monoterpenic hydrocarbons, the dominant component being limonene. The antibacterial and antifungal activities of the oils were examined and compared with Streptomycin and bifonazole, and both oils showed slightly more activity. In a study of the composition of essential oil obtained from the leaves of *Cotinus coggygria* Scop., Demirci et al. [6] also reported that the dominant component was limonene, but found that the oil comprised 42 components. Savikin et al. [7] determined the total phenol content in extracts from the flowers and leaves of *Cotinus coggygria* to be 76.5±4.2 and

Table 1. Inhibition zone diameters of extracts of *Cotinus coggygria*.

	Microorganisms						
	Sa	Ef	Se	Bs	St	Pa	Ec
Extracts	Inhibition zones (mm)						
Acetone							
1600 µg	10	15	11	0	0	9	0
800 µg	9	13	10	0	0	8	0
400 µg	8	9	9	0	0	7	0
200 µg	0	8	8	0	0	0	0
Control	0	0	0	0	0	0	0
Petroleum ether							
1600 µg	0	0	0	0	0	0	0
800 µg	0	0	0	0	0	0	0
400 µg	0	0	0	0	0	0	0
200 µg	0	0	0	0	0	0	0
Control	0	0	0	0	0	0	0
Ethanol							
1600 µg	14	15	11	0	0	8	9
800 µg	12	13	9	0	0	7	8
400 µg	9	9	7	0	0	0	0
200 µg	7	0	0	0	0	0	0
Control	0	0	0	0	0	0	0
Chloroform							
1600 µg	0	0	0	0	0	0	0
800 µg	0	0	0	0	0	0	0
400 µg	0	0	0	0	0	0	0
200 µg	0	0	0	0	0	0	0
Control	0	0	0	0	0	0	0
Methanol							
1600 µg	17	19	14	0	0	9	9
800 µg	16	18	13	0	0	8	8
400 µg	13	14	12	0	0	7	0
200 µg	10	9	8	0	0	0	0
Control	0	0	0	0	0	0	0
Distilled water							
1600 µg	16	20	16	0	0	7	0
800 µg	15	19	14	0	0	0	0
400 µg	11	15	13	0	0	0	0
200 µg	8	10	9	0	0	0	0
Control	0	0	0	0	0	0	0
Gentamicin (30 µg)	20	21	24	26	22	13	21
Ceftriaxone (30 µg)	22	24	25	0	26	16	18

Sa – *Staphylococcus aureus*, Ef – *Enterococcus faecalis*, Se – *Staphylococcus epidermidis*, Bs – *Bacillus subtilis*, St – *Salmonella typhimurium*, Pa – *Pseudomonas aeruginosa*, Ec – *Escherichia coli*

515.5±8.3 mg $GAEg^{-1}$, and the tannin content to be 13.7%±0.9% and 18.5%±1.1%, respectively. Dülger et al. [8] determined that raw plant extract of *Cotinus coggygria* Scop. in ethanol showed antimicrobial activity against *Bacillus cereus*, *Bacillus subtilis*, *Staphylococcus aureus*, *Micrococcus luteus*, *Escherichia coli*, *Enterobacter aerogenes*, *Proteus vulgaris*, *Pseudomonas aeruginosa*, *Pseudomonas putida*, *Salmonella typhimurium*, *Salmonella typhi*, *Hanseniaspora guilliermondii*, *Rhodotorula rubra*, *Kluyveromyces fragilis*, *Kluyveromyces marxianus*, *Debaryomyces hansenii*, *Candida utilis*, and *Candida albicans*. According to the results of the present study, extracts of *Cotinus coggygria* prepared in acetone, ethanol, methanol and distilled water had significant antibacterial effects against *Staphylococcus epidermidis*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *Enterococcus faecalis*; the extracts of *Cotinus coggygria* in ethanol and methanol were determined to have antibacterial effect against *Escherichia coli*, and to have no antibacterial effect against *Bacillus subtilis* and *Salmonella typhimurium*.

The results of the present study, that *Cotinus coggygria* extract in methanol had an antibacterial effects against *Staphylococcus aureus*, supports the results reported by Matic et al. [9]. However, results of Matic et al. [9] on the antibacterial effect of the extract in methanol against *Escherichia coli* and *Bacillus subtilis* differed from the results of the present study. Matic et al. suggested that the extract had an antibacterial effect against *Bacillus subtilis* [9], while the present study determined that the extract did not have any antibacterial effect against *Bacillus subtilis*. The study of Matic et al. found that the inhibition zone of the extract against *Escherichia coli* was 29±1 mm, 15±0.5 mm, and 17±0.5 mm for the following doses of 150 µg, 300 µg and 500 µg, respectively; while the present study determined that the extract in methanol was found to result in an inhibition zone only for the doses of 1,600 µg and 800 µg, and no inhibition zone occurred for the dose of 400 µg. A study of the antibacterial activity of the extract of *Cotinus coggygria* leaves in ethanol [10] reported inhibition zones of 13 mm against *Staphylococcus aureus* and 10 mm against *Pseudomonas aeruginosa*; and that it did not have any antibacterial effect against *Escherichia coli*. The results of the above-mentioned study and the present study obtained against *Staphylococcus aureus* and *Pseudomonas aeruginosa* were found to support each other. However, inhibition zones of 9 mm and 8 mm were observed against *Escherichia coli* for the extract doses of 1,600 µg and 800 µg; and no inhibition zone occurred for the dose of 400 µg. The present study is the first study examining the antibacterial effect of the extracts obtained in 6 different solvents against 7 different microorganisms.

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