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In *vitro* Antimicrobial Activity of Methanolic Extract of *Apium graveolens*

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ABSTRACT

The aims *of our research were analysis of the secondary metabolite products and in vitro antibacterial and anti-fungal activities. Apium graveolens has been used as a food, and at various times both the whole plant and the seeds have been consumed as a medicine. The FTIR analysis of Apium graveolens leaves proved the presence of functional group assignment Alkyl halides, Amide, and Alkane with Intensity 75.578 (Strong), 87.413 (Strong), 86.158 (Strong), 84.616 (Bending), 88.087 (Strong), and Peak (Wave number cm-[1]) 1020.34, 1238.30, 1317.38, 1608.63 and 2918.30. In the current study, the anti-microbial activity of Apium graveolens methanolic extract was highly against Klebsiella pneumoniae (4.27 ± 0.16). Apium graveolens was very highly active against A. terreus (5.01 ± 0.17).*

Keywords: *FT-IR analysis, Apium graveolens, Anti-Bacterial, Anti-Fungal Activity*

Introduction

Celery (*Apium graveolens*) is widely used as a medicinal herb or spice, with prominent antioxidant properties, due to the presence of many bioactive components, mainly phenolic compounds [1]. An understanding of changes in phenolic content and antioxidant activity occurring during preservation of celery is important to develop appropriate drying method and optimal conditions of drying [2-5]. *Apium graveolens* is a marshland plant in the family Apiaceae that has been cultivated as a vegetable since antiquity [6]. Celery has a long fibrous stalk tapering into leaves. Depending on location and cultivar, either its stalks, leaves or hypocotyl are eaten and used in cooking. Celery seed is also used as a spice and its extracts have been used in herbal medicine [7-10].

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Materials and Method

Collection and preparation of plant material: The leaves were purchased from local market in Hilla city, middle of Iraq. After thorough cleaning and removal foreign materials, the leaves were stored in airtight container to avoid the effect of humidity and then [11-17] stored at room temperature until further use.

Preparation of sample: About 20 grams of the plant sample powdered were soaked in 100 ml methanol for 16 hours in a rotatory shaker. Whatman No.1 filter paper was used to separate the extract of plant [18-22]. The filtrates were used for further phytochemical analysis. It was again filtered through sodium sulphate in order to remove the traces of moisture.

Fourier transform infrared spectrophotometer (FTIR): The powdered sample of *Apium graveolens* was treated for FTIR spectroscopy (Shimadzu, IR Affinity, Japan). The sample was run at infrared region between 400 nm and 4000 nm.

Determination of antimicrobial activity of crude bioactive compounds of *Apium graveolens*: The test pathogens were swabbed in Müller-Hinton agar plates. Sixty µ*L* of plant extract was loaded on the bored wells. Antifungal activity was evaluated by measuring the zone of inhibition against the test microorganisms. Methanol

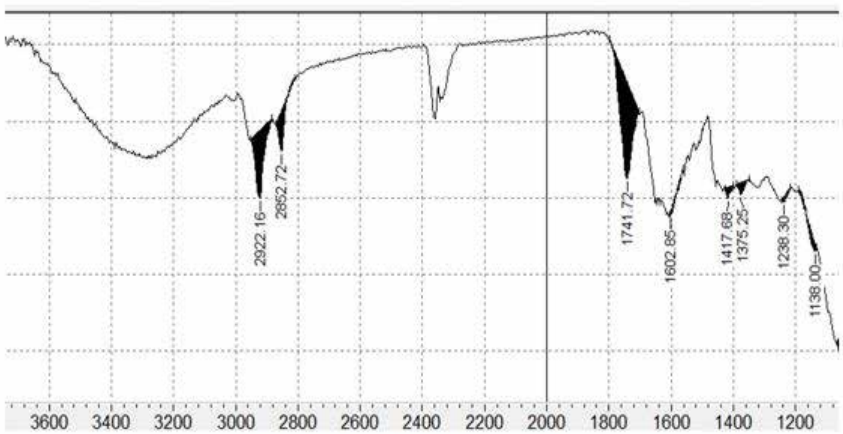
was used as solvent control [23-34]. Amphotericin B and fluconazole were used as reference antifungal agent. The tests were carried out in triplicate. The antifungal activity was evaluated by measuring the inhibition-zone diameter observed after 48 h of incubation.

Results and Discussion

Identification of biochemical compounds: Analysis of compounds was carried out in methanolic extract of *Apium graveolens*, shown in **Table 1.** Analysis of the methanol extract of *Apium graveolens* showed the presence of five major peaks. The FTIR analysis of *Apium graveolens* leaves proved the presence of functional group assignment Alkyl halides, Amide, and Alkane with Intensity 75.578 (Strong), 87.413 (Strong), 86.158 (Strong), 84.616 (Bending), 88.087 (Strong), and Peak (Wave number cm-[l]) 1020.34, 1238.30, 1317.38, 1608.63 and 2918.30. In the current study, the anti-microbial activity of *Apium graveolens* methanolic extract was highly against *Klebsiella pneumoniae* (4.27 ± 0.16). *Apium graveolens* was very highly active against *A. terreus* (5.01 ± 0.17). The effect of *Apium graveolens* essential oils on bacterial and yeast growth was studied by the Paper-Disk plate method by measuring the inhibition zone. Based on the present study, it is concluded that the whole plants of *Apium graveolens* contains various bioactive components with high degree of antibacterial activity against various pathogens. It is hoped that this study would direct to the establishment of some compounds that could be used to invent new and more potent antibacterial drugs of natural origin. Further work will emphasize the isolation and characterization of active principles responsible for bio-efficacy and bioactivity [35-42]. Flavonoids and other phenolic compounds spread widely in plants, and their diverse biological activities such as antioxidant effects have been investigated in many studies such as coronary heart diseases, diabetes, and cancer. Medicinal herbs have fewer side effects than chemical drugs and their antioxidant attributes decrease the toxicity of these drugs. Today herbal drugs are used as an alternative to chemical drugs and the main reason is their low level of side effects compared with chemical drugs [43-50]. WHO encourages countries to provide safe and effective traditional remedies and practices in public and private health services and it also published two monographs on medicinal plants with information on pharmacopoeial summaries for quality assurance: botanical features, distribution, identity tests, purity requirements, chemical assays, and active or major chemical constituents, clinical applications [51], pharmacology, contraindications, warnings, precautions, potential adverse reactions, and posology.

Table 1: FT-IR peak values of *Apium graveolens* methanolic leaves extract

No.	Peak (Wave number cm-[l])	Intensity	Type of Intensity	Bond	Type of Vibration	Functional group assignment	Group frequency
1.	1020.34	75.578	Strong	C-F	Stretch	alkyl halides	1000-1400
2.	1238.30	87.413	Strong	C-F	Stretch	alkyl halides	1000-1400
3.	1317.38	86.158	Strong	C-F	Stretch	alkyl halides	1000-1400
4.	1608.63	84.616	Bending	N-H	Stretch	Amide	1550-1640
5.	2918.30	88.087	Strong	C-H	Stretch	Alkane	2850-3000



Wavenumber (cm^{-1})

Figure 1: Fourier-transform infrared spectroscopic profile solid analysis of *Apium graveolens*

Conclusion

Medicinal property of *Apium graveolens* methanolic extract is due to presence of secondary metabolites. Five phytoconstituents were identified by (FTIR) analysis. This plant derived bioactive compounds used as source of antibiotic properties and pharmaceutical industries used for drug formulation. Analysis of *Apium graveolens* leaves proved the presence of functional group assignment Alkyl halides, Amide, and Alkane with Peak (Wave number cm^{-1}) 1020.34, 1238.30, 1317.38, 1608.63 and 2918.30. In the current study, the anti-microbial activity of *Apium graveolens* methanolic extract was highly against *Klebsiella pneumoniae* (4.27 ± 0.16). *Apium graveolens* was very highly active against *A. terreus* (5.01 ± 0.17).

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Conflict of Interest: None to declare.

Ethical Clearance: In our research, all protocols were approved under the Department of Biology, College of Science for women, University of Babylon, Hillah city, Iraq and all methods were carried out in accordance with approved guidelines.

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