

Comparison of Average Inhibition Zones of Methanolic Extracts of *Chaetomium globosum* on the Growth of Different Groups of Pathogenic Micro-Organisms

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Abstract

The objectives of this study were analysis of the secondary metabolite products and evaluation of anti-bacterial activity. The FTIR analysis of *Chaetomium globosum* proved the presence of functional group assignment Alkyl halides, Amide, and Alkane with Peak (Wave number cm^{-1}) 1018.41 (Strong), 1238.30 (Strong), 1317.38 (Strong), 1379.10 (Strong), 1614.42 (Bending), 2850.79 (Strong), 2920.23 (Strong). Zone of inhibition (mm) of test bacterial strains to *Chaetomium globosum* bioactive compounds and standard antibiotics were (4.00±0.31), (4.77±0.13), (5.00±0.16), (3.22±0.41), and (4.29±0.11) uses *Chaetomium globosum* bioactive compounds, and (2.01±0.10), (1.77±0.41), (1.98±0.11), (2.00±0.30), and (1.05±0.42) uses Rifampin, and (2.42±0.18), (2.12±0.46), (1.40±0.12), (1.00±0.10), and (2.90±0.47) uses Kanamycin for *Staphylococcus aureus*, *Escherichia coli*, *Proteus mirabilis*, *Klebsiella pneumonia*, *Pseudomonas euogenosa* respectively. *Chaetomium globosum* was very highly active against *Escherichia coli* (4.77±0.13).

Keywords: *Chaetomium globosum*, FT-IR, Secondary metabolites.

Introduction

Chaetomium species are widespread worldwide in soil and plant debris. *Chaetomium globosum* is a well-known mesophilic member of the mold family Chaetomiaceae. It is a saprophytic fungus that primarily resides on plants¹, soil, straw, and dung. Both the *C. globosum* hyphae and the spores contain antigens such as Chg45, to induce IgE and IgG antibody production in allergic individuals. Although the IgE upsurge is transient, increased IgG levels persist in the serum. This can lead to non-atopic asthma, sinusitis, and respiratory illnesses in the residents of contaminated buildings.² Such allergic onsets can be prevented with the use of potassium chlorate in building materials. Chlorate, toxic to many fungal strains, disrupts nitrate reduction in fungi by using fungal nitrate reductase to produce the toxic chlorite. Although it is unclear as to whether *C. globosum* contains nitrate reductase, chlorate is still a well known *C. globosum* toxin. However, even though chlorate suppresses perithecia formation, it does not affect hyphal growth nor sporulation. Secondary metabolites often

play an important role in plant defense against herbivory and other interspecies defenses. Humans use secondary metabolites as medicines, flavourings, pigments, and recreational drugs⁴. Secondary metabolites aid a host in important functions such as protection, competition, and species interactions, but are not necessary for survival. One important defining quality of secondary metabolites is their specificity. Usually, secondary metabolites are specific to an individual species, though there is considerable evidence that horizontal transfer across species or genera of entire pathways plays an important role in bacterial (and, likely, fungal) evolution. Research also shows that secondary metabolism can affect different species in varying ways. In the same forest, four separate species of arboreal marsupial folivores reacted differently to a secondary metabolite in eucalypts.⁶

Materials and Method

After growing on potato dextrose agar (PDA) medium at 25°C for 4 days, the fresh mycelium of strain *C. globosum* No. 04 was inoculated in liquid medium

containing: Oat flour 80 g, maltose 10 g, yeast extracts 2 g dissolved in 1,000 mL dH₂O. The pH was adjusted to 6.0 before autoclaving. Fermentation was carried out in 2 L flasks each containing 1 L medium on a rotary shaker at 180 r/min, 25 °C for 8 days, and the cultures were used for the extraction and isolation.

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

Antibacterial activity: Determination of antibacterial activities of pure extract of *C. globosum* cultures performed using streak-plate method. Mueller Hinton agar plates were prepared and inoculated with *C. globosum* cultures by a single streak of inoculum in the center of the petri dish and incubated at 27°C for 4 days. Antagonism was measured by the determination of the size of the inhibition zone in millimeters⁷.

Results and Discussion

The FTIR analysis of *Chaetomium globosum* proved the presence of functional group assignment Alkyl halides, Amide, and Alkane with Peak (Wave number cm⁻¹) 1018.41 (Strong), 1238.30 (Strong), 1317.38 (Strong), 1379.10 (Strong), 1614.42 (Bending), 2850.79 (Strong), 2920.23 (Strong). Zone of inhibition (mm) of test bacterial strains to *Chaetomium globosum* bioactive compounds and standard antibiotics were (4.00±0.31), (4.77±0.13), (5.00±0.16), (3.22±0.41), and (4.29±0.11) uses *Chaetomium globosum* bioactive compounds, and (2.01±0.10), (1.77±0.41), (1.98±0.11), (2.00±0.30), and (1.05±0.42) uses Rifambin, and (2.42±0.18), (2.12±0.46), (1.40±0.12), (1.00±0.10),

and (2.90±0.47) uses Kanamycin for *Staphylococcus aureus*, *Escherichia coli*, *Proteus mirabilis*, *Klebsiella pneumonia*, *Pseudomonas eurogenosa* respectively. *Chaetomium globosum* was very highly active against *Escherichia coli* (4.77±0.13). Infrared spectroscopy provides a useful method for herbal analysis and elucidate the compounds structures as well as for quantitative analysis of drugs. Recently, a number of plants have been reported for antibacterial properties across the world¹⁹. 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. The differences in the susceptibilities of Gram positive and Gram negative bacteria to *Streptomyces* extracts have been observed by previous workers¹³. Gram negative bacteria are inherently more resistant to antimicrobials than Gram positive organisms and this has been ascribed to the combined exclusion of antimicrobial compounds by double membrane barrier and transmembrane efflux present in this group of organisms. The three main classes of fungal secondary metabolites are: polyketides, nonribosomal peptides and terpenes. Although fungal SMs are not required for growth they play an essential role in survival of fungi in their ecological niche¹¹. The goal of absorption spectroscopy techniques (FTIR, ultraviolet-visible (“UV-Vis”) spectroscopy, etc.) is to measure how much light a sample absorbs at each wavelength. The most straightforward way to do this, the “dispersive spectroscopy” technique, is to shine a monochromatic light beam at a sample, measure how much of the light is absorbed, and repeat for each different wavelength. (This is how some UV-vis spectrometers work, for example).

Table 1. FT-IR peak values of solid analysis of *Chaetomium globosum*

No.	Peak (Wave number cm ⁻¹)	Intensity	Corr. Area	Type of Intensity	Bond	Type of Vibration	Functional group assignment	Group frequency
1.	1018.41	61.727	0.277	Strong	C-F	Stretch	alkyl halides	1000-1400
2.	1238.30	81.739	0.396	Strong	C-F	Stretch	alkyl halides	1000-1400
3.	1317.38	83.193	0.054	Strong	C-F	Stretch	alkyl halides	1000-1400
4.	1379.10	81.889	0.035	Strong	C-F	Stretch	alkyl halides	1000-1400
5.	1614.42	79.693	0.163	Bending	N-H	Stretch	Amide	1550-1640
6.	2850.79	86.184	0.321	Strong	C-H	Stretch	Alkane	2850-3000
7.	2920.23	81.949	0.993	Strong	C-H	Stretch	Alkane	2850-3000

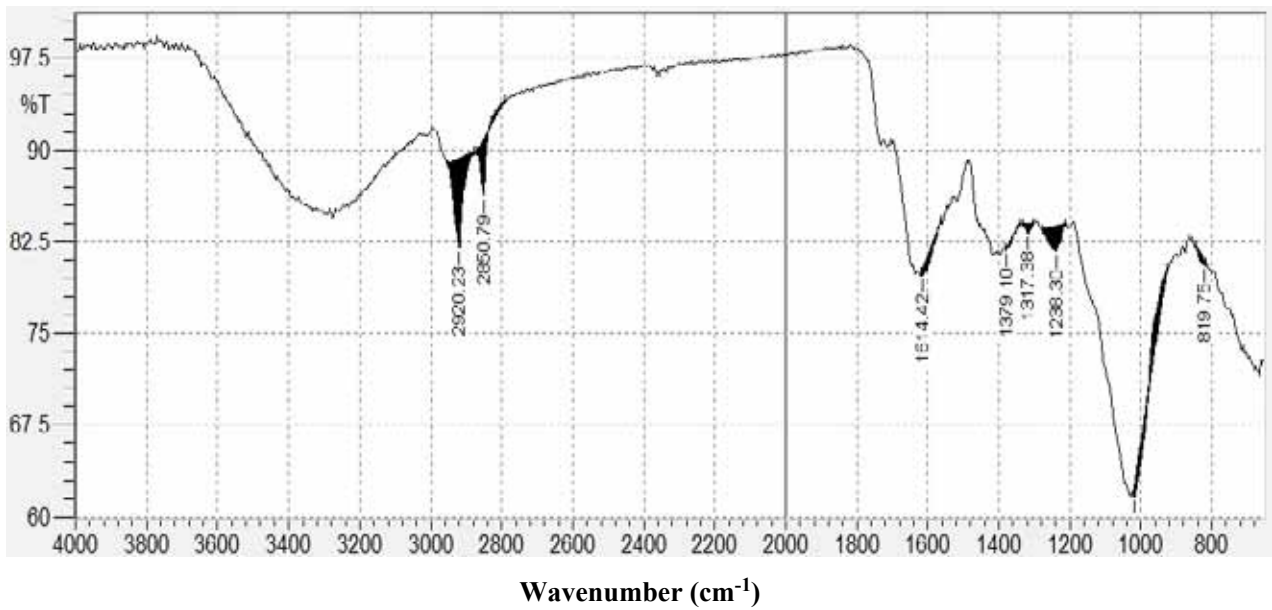


Figure 1. Fourier-transform infrared spectroscopic profile solid analysis of *Chaetomium globosum*

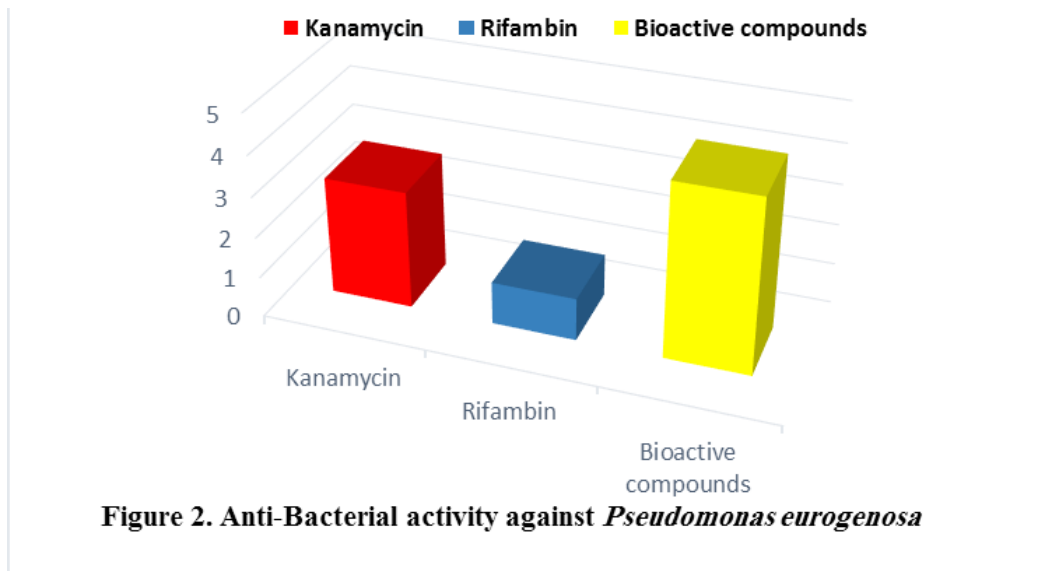


Figure 2. Anti-Bacterial activity against *Pseudomonas eurogenosa*

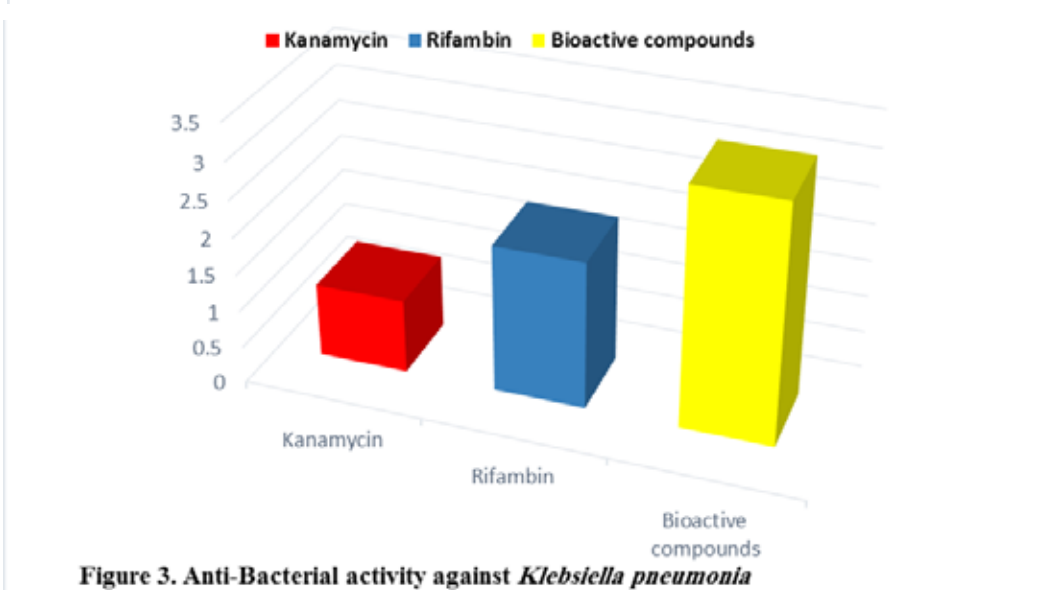


Figure 3. Anti-Bacterial activity against *Klebsiella pneumonia*

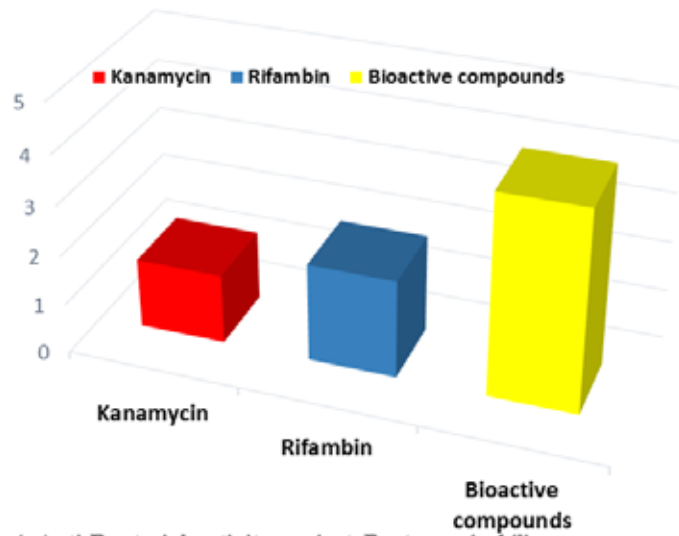


Figure 4. Anti-Bacterial activity against *Proteus mirabilis*

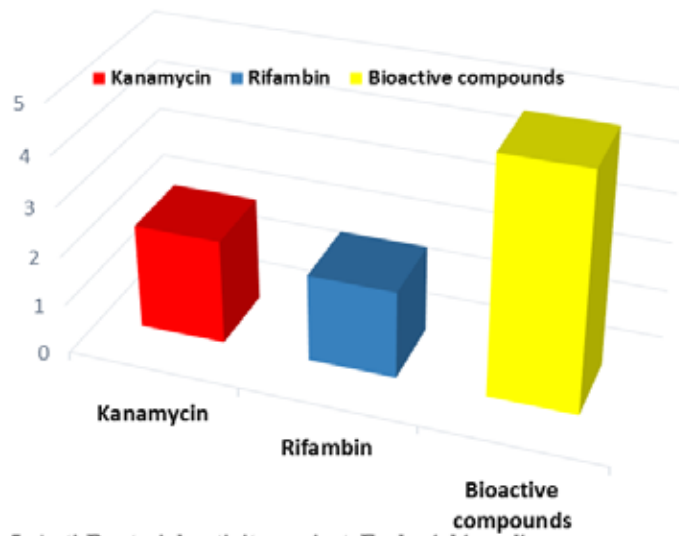


Figure 5. Anti-Bacterial activity against *Escherichia coli*

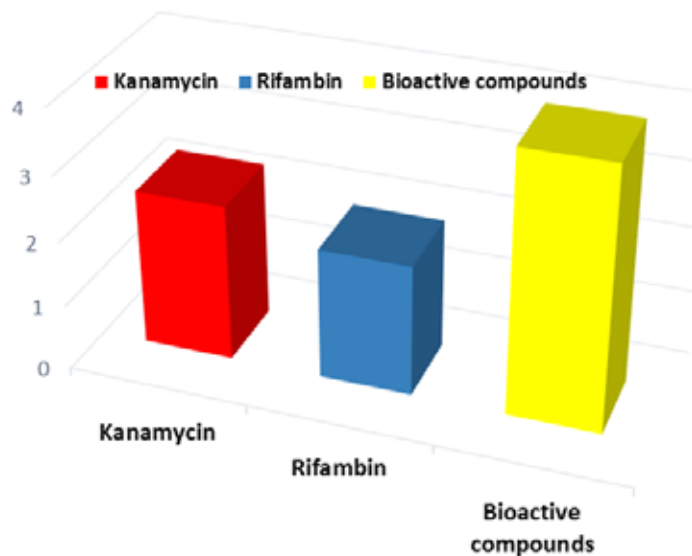


Figure 6. Anti-Bacterial activity against *Staphylococcus aureus*

Conclusion

Chaetomium globosum proved the presence of functional group assignment Alkyl halides, Amide, and Alkane. *Chaetomium globosum* bioactive compounds and standard antibiotics were (4.00±0.31), (4.77±0.13), (5.00±0.16), (3.22±0.41), and (4.29±0.11) uses *Chaetomium globosum* bioactive compounds, and (2.01±0.10), (1.77±0.41), (1.98±0.11), (2.00±0.30), and (1.05±0.42) uses Rifampin, and (2.42±0.18), (2.12±0.46), (1.40±0.12), (1.00±0.10), and (2.90±0.47) uses Kanamycin for *Staphylococcus aureus*, *Escherichia coli*, *Proteus mirabilis*, *Klebsiella pneumonia*, *Pseudomonas eurogenosa* respectively. *Chaetomium globosum* was very highly active against *Escherichia coli* (4.77±0.13).

Financial Disclosure: There is no financial disclosure.

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 method were carried out in accordance with approved guidelines.

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