Women's Application in Underrepresented Subjects

The Women University of Azad Jammu and Kashmir (WUAJ&K), Bagh, is working to empower women through education and research across all disciplines, including the Faculty of Science and Technology, Arts and Social Sciences, and Allied Health Sciences. As in national and global contexts, female participation in STEM fields, particularly mathematics, physics, and chemistry, as well as in the arts and social sciences, remains underrepresented. To address this gap, the university undertakes several initiatives to achieve this target:

Targeted Outreach Programs

The WUAJ&K initiated targeted outreach programs to improve the women's applications in underrepresented subjects, including the organization of seminars, national and international conferences, and training sessions with students and community members. Evidence of a few of these initiatives is provided in the **Annex. I**.

Collaborative Initiatives with other Institutions

The WUAJ&K actively engages in collaborative initiatives with national and international universities and research organizations to promote women's participation in underrepresented subjects. These collaborations include joint research projects, faculty exchange programs, co-hosting of seminars and conferences, and partnerships with community organizations and NGOs. Evidence of selected collaborative initiatives is provided in **Annex II**.

Awareness and Motivation Campaigns

WUAJ&K organizes awareness and motivation campaigns in local schools and colleges, focusing on improving the quality of teaching and learning in STEM subjects. By engaging teachers and students through workshops, training sessions, and motivational talks, these campaigns enhance subject interest. As a result, the confidence of female students in mathematics, physics, chemistry, and related fields increases, leading to higher admission rates in underrepresented subjects. Evidence of these campaigns is provided in **Annex III**.

Scholarships and Less Fee Strucutre in Underrepresented Disciplines

WUAJ&K provides scholarships and financial incentives to encourage female students to pursue studies in all fields. Merit-based awards, need-based support, and recognition for outstanding performance are offered to reduce financial barriers and increase enrollment in underrepresented disciplines. However, specifically to support the underrepresented subjects, the fee strucutre is significiantly lower in STEM subjects and arts and social sciences as compared to pharmacy and other allied health sciences subjects to motivate toward these subjects. (**Annex IV**)

Student and Faculty Achievements in STEM

Students and faculty of WUAJ&K have made significant contributions in STEM, including publications, conference presentations, and participation in national and international competitions. These achievements highlight the university's commitment to advancing women's presence and excellence in science and technology. (**Annex V**)

Annex. I

American Studies Workshop fostering global perspectives and academic collaboration for enhanced educational experiences

18-19 November 2024

Dr. Aleosnita from Malaysia on "Artificial Intellegence in Education"

August 22-24, 2024

International Speakers in Conference

August 22-24, 2024

Prof. Dr. S.A. Salman (IRAN)

Dr. Aleosnita (Malaysia)

Through AIPS, students gained global exposure and built meaningful academic connections in the USA

2024

Annex. II

MINISTÉRIO DA EDUCAÇÃO
UNIVERSIDADE FEDERAL DO PIAUÍ
PRO-REITORIA DE ENSINO DE PÓS GRADUAÇÃO
COORDENAÇÃO DO PROGRAMA DE PÓS-GRADUAÇÃO EM CIÊNCIA E ENGENHARIA DOS MATERIAIS
Pro-Reitoria de Ensino de Pós Graduação, Campus Ministro Petrônio Portela, Bairro Ininga, Teresina, Piauí, Brasil, CEP 64049-550.
Homepage: ppgcm.ufpi.br - E-mail: materiais@ufpi.edu.br – Tel: 86 3237-1057

Teresina, Piauí, Brazil
July 24, 2025
Research Proposal Support Letter

Evaluation Committee

Announcement: NRPU by Higher Education Commission, Pakistan

I am writing this letter to express PPGCM/UFPI's institutional support to the research proposal titled "Metallic and Metal-Oxide Nanoparticles Synthesis by Atmospheric Pressure Microplasma and their Biomedical Applications presented by Dr. Muhammad Naeem who works as Assistant Professor in Women University of Azad Jammu And Kashmir, Bagh, Pakistan.

I am expressing this support based on the close research collaboration in materials processing carried out during the last years between Dr. Naeem and some researchers at UFPI. This collaboration has let the generation and assimilation of useful knowledge as well as the graduate student generation in our postgraduate programs.

Sincerely

Dr. Anderson de Oliveira Lobo
Postgraduate Program in Materials Science and Engineering at the Federal University of Piauí - PPGCM/UFPI
Program Coordinator

MINISTÉRIO DA EDUCAÇÃO
UNIVERSIDADE FEDERAL DO PIAUÍ
CENTRO DE TECNOLOGIA
COORDENAÇÃO DO PROGRAMA DE PÓS-GRADUAÇÃO EM CIÊNCIA E ENGENHARIA DOS MATERIAIS
Centro de Tecnologia, Campus Ministro Petrônio Portela, Bairro Ininga, Teresina, Piauí, Brasil, CEP 64049-550.
Homepage: ppgcm.ufpi.br - E-mail: materiais@ufpi.edu.br – Tel: 86 3237-1057

Evaluation Committee

It is a pleasure for me to inform you that this researcher, Dr. Rômulo Ribeiro Magalhães de Sousa, and other researchers in the postgraduate program in Materials Science and Engineering at the Federal University of Piauí - PPGCM/UFPI, have been working closely in scientific investigations with the Dr. Muhammad Naeem, who currently works as an Assistant Professor of Physics at Women University of Azad Jammu And Kashmir. As a result of this collaborative work, several scientific papers has been generated and published in prestigious international journals.

I also want to declare that due to the exceptional work of collaboration with us from PPGCM/UFPI, Dr. Naeem has access to various equipment to carry out characterizations for the elaboration of scientific works. We believe that the availability of this equipment will help the goals and objectives of the project titled “Metallic and Metal-Oxide Nanoparticles Synthesis by Atmospheric Pressure Microplasma and their Biomedical Applications” to be successfully achieved.

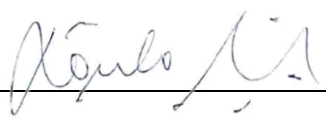
Among the available equipment, the following stand out:

- Scanning electron microscope
- Optical microscope
- Raman Spectroscopy Technique
- X-ray diffraction technique
- Pin on Disk Tribometer with capacity for register friction coefficient and carry wet tests at different normal loads and test velocities.
- Micro indentation technique.
- Vickers, Rockwell and Brinell scales hardness.
- Equipment for metallic samples preparation and metallographic analysis.

As a request of Dr. Naeem, the present is extended in Teresina-Piauí, Brazil in July 2025

Please contact me for any additional information.

Sincerely.



Dr. Rômulo Ribeiro Magalhães de Sousa

Physics of Materials Group Researcher

PPGCM/UFPI

Scopus

Women University of Azad Jammu & kashmir Bagh

Bagh, Pakistan 60276224

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University of the Punjab	37
Government College University Lahore	36
King Saud University	33

Organization name	Documents
Universidade Federal do Piauí	31
PMAS-Arid Agriculture University Rawalpindi	31
Universidade Federal do Rio Grande do Norte	29
COMSATS University Islamabad	28
The Islamia University of Bahawalpur	28
Abdul Wali Khan University Mardan	28
College of Sciences	27
Government College University Faisalabad	27
University of Lahore	27
Consejo Nacional de Humanidades, Ciencias y Tecnologías	26
Central South University	24
Islamia College, Peshawar	23
Riphah International University	19
University of Veterinary and Animal Sciences, Lahore	19
Mirpur University of Science and Technology	19
University of Agriculture, Faisalabad	18
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Organization name	Documents
Shenzhen University	17
COMSATS Institute of Information Technology Lahore	17
COMSATS University Islamabad, Abbottabad Campus	17
Hazara University Pakistan	17
Pakistan Institute of Engineering and Applied Sciences	17
Ilia State University (ISU)	16
Xi'an Jiaotong University	15
University of Birmingham	15
Chinese Academy of Sciences	14
King Abdulaziz University	14
King Khalid University	14
The Botanical Institute, Ilia State University	14
University of Karachi	12
University of Education	12
University of Gujrat	12
Kohat University of Science and Technology	12
University of Okara	12

Organization name	Documents
University of Kotli	12
Shanghai Jiao Tong University	11
Tsinghua University	10
United Arab Emirates University	10
Universidad Autónoma de Coahuila	10
Cholistan University of Veterinary & Animal Sciences, Bahawalpur	10
Women University Swabi	10
Staatliches Museum für Naturkunde Karlsruhe	10
Latvijas Universitāte	9
University of Sargodha	9
BUITEMS - Balochistan University of Information Technology, Engineering and Management Sciences	9
Georgia Institute of Technology	8
College of Engineering	8
National University of Sciences and Technology	8
International Islamic University, Islamabad	8
Pakistan Institute of Nuclear Science and Technology	8
Université Mustapha Stambouli de Mascara	8

Organization name	Documents
Ministry of Education of the People's Republic of China	7
University of Electronic Science and Technology of China	7
China Medical University	7
Qatar University	7
Università del Salento	7
Prince Sattam Bin Abdulaziz University	7
Taif University	7
Faculty of Sciences, King Abdulaziz University	7
Princess Nourah Bint Abdulrahman University	7
Jazan University	7
Bahauddin Zakariya University	7
Lahore College for Women University	7
Allama Iqbal Open University	7
Ghazi University	7
University of Chinese Academy of Sciences	6
Zhejiang University	6
Universidade Federal de São Carlos	6

Organization name	Documents
Imam Mohammad Ibn Saud Islamic University	6
King Fahd Medical Research Center	6
The University of Haripur	6
National Institute for Biotechnology and Genetic Engineering Pakistan	6
University of Balochistan	6
CSIC - Instituto de Productos Naturales y Agrobiologia (IPNA)	6
Beijing University of Chemical Technology	5
Umm Al-Qura University	5
Sichuan Normal University	5
Wrocław University of Environmental and Life Sciences	5
Shandong University, Weihai	5
Chengdu Institute of Biology Chinese Academy of Sciences	5
Northern Border University	5
Prince Mohammad Bin Fahd University	5
University of Malakand	5
University of Bisha	5
University of Central Punjab	5

Organization name	Documents
Capital University of Science & Technology	5
University of Swat	5
Department of Mathematics, Statistics and Physics, College of Arts and Sciences, Qatar University	5
Cornell University	4
The University of Sheffield	4
Universiti Kebangsaan Malaysia	4
University of KwaZulu-Natal	4
Harbin Engineering University	4
China Medical University Hospital	4
Zhejiang Normal University	4
Minia University	4
University of Engineering and Technology, Lahore	4
Sunway University	4
Westlake University	4
Faculty of Science	4
University of Zagreb, Faculty of Agriculture	4
Ghulam Ishaq Khan Institute of Engineering Sciences and Technology	4

Organization name	Documents
Dibrugarh University	4
Saudi Electronic University	4
New Valley University	4
Faculty of Science	4
University of Wah	4
Abbottabad University of Science and Technology	4
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Glocal University	4
Università degli Studi di Scienze Gastronomiche	4
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Annex. III

Training of Elementary Teachers for Quality Education in Schools

Plan Quality Finance

July, 2024

Training of female faculty members in collaboration with DEO (Female) focused on teaching methodology and quality education

1 January, 2024

THE WOMEN UNIVERSITY

OF AZAD JAMMU & KASHMIR, BAGH. Website: www.wuajk.edu.pk

Registrar office
(General section)

Date: 09-05-2024

Notification:

No.WUB/ARO/ (G)1850-58/2024 .On the recommendations of University Fee and Funds Committee, the Vice Chancellor, Subject to the approval of the Academics Council and Senate has been pleased to approve the following revised rates of fee and fund for admission in BS Physics, BS Chemistry, BS Botany, BS Biotechnology, BS Microbiology, BS Environmental Sciences, BS Zoology, BS Mathematics and BS Statistics, BS Computer Science, BS Data Science and BS Poultry Sciences in Faculty of Science & Technology (Four Years Duration) for Academic Session Fall 2024 and onward.

BS Physics, BS Chemistry, BS Botany, BS Biotechnology, BS Microbiology, BS Environmental Sciences, BS Zoology, BS Mathematics and BS Statistics, BS Computer Science, BS Data Science and BS Poultry Sciences and Equivalent									
Fee Codes	**1st Semester**	**2nd Semester**	**3rd Semester**	**4th Semester**	**5th Semester**	**6th Semester**	**7th Semester**	**8th Semester**	**9th Semester and onward (if applicable)**
A.F001(Admission Fee	5,280	-	-	-	-	-	-	-	
F002(Registration Fee)	2,750	-	-	-	-	-	-	-	
F003((Security Fee) (Refundable)	3,300	-	-	-	-	-	-	-	
Sub. Total A.	11,330	-	-	-	-	-	-	-	
Sub. Total. B. F004((Tuition Fee)	29,700	29,700	32,670	32,670	35,940	35,940	40,530	40,530	
C.F005(Library Fee/Lab/IT)	3,960	3,960	4,360	4,360	4,800	4,800	5,280	5,280	
F006(Examination Fee)	2,090	2,090	2,200	2,200	2,420	2,420	2,650	2,660	
F007 (Sports Fee)	660	660	730	730	850	850	950	950	
F011(Transcript Fee)								1,300	
F012 (Endowment Fund)	770	770	850	850	930	930	1025	1025	55,695
F013(Development charges)	660	660	730	730	850	850	950	950	
F014(Thesis/Report Writing)	-					-	-	1,100	
F015 (Transport Fee)	880	880	970	970	1065	1065	1175	1175	
F016 (Student's Guardian Indemnity)	550	550	600	600	660	660	725	725	
Sub-Total C:	9,570	9,570	10,440	10,440	11,575	11,575	12,765	15,165	
Grand Total (A+B+C)	50,600	39,270	43,110	43,110	47,515	47,515	53,295	55,695	

* Students applying for admission in 5th Semester (Lateral Entry) will pay admission fee (F001), Registration Fee (F002) and Security (F003) along with total semester fee in 5th semester.

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Fee Structure Social Sciences

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(General section)

Date: 09-05-2024

Notification:

No.WUB/ARO/ (G) 1859-67/2024, on the recommendations of University Fee and Funds Committee, the Vice Chancellor, Subject to the approval of the Academics Council and Senate has been pleased to approve the following revised rates of fee and fund for admission in B.Ed. (Hons.) (Elementary/Secondary,) BS Psychology, BS English, BS Sports Sciences & Physical Education, BS Economics, BS Economics & Finance, BS Islamic Banking & Finance, BBA, B.Com, BS International Relations, BS Sociology, BS Islamic Studies, BS Anthropology and BS Mass Communication & Media Studies in Faculty of Arts & Social Sciences (Four Years Duration) for Academic Session fall 2024 and onward.

B.Ed. (Hons.) (Elementary/Secondary,) BS Psychology, BS English, BS Sports Sciences & Physical Education, BS Economics, BS Economics & Finance, BS Islamic Banking & Finance, BBA, B.Com, BS International Relations, BS Sociology, BS Islamic Studies, BS Anthropology and BS Mass Communication & Media Studies and Equivalent

Fee Codes	1st Semester	2nd Semester	3rd Semester	4th Semester	5th Semester	6th Semester	7th Semester	8th Semester	
A. F001(Admission Fee	5,280	-	-	-	-	-	-	-	9th Semester and onward (if applicable)
F002(Registration Fee)	2,750	-	-	-	-	-	-	-	
F003((Security Fee) (Refundable)	3,300	-	-	-	-	-	-	-	
Sub. Total. A.	11,330	-	-	-	-	-	-	-	
Sub. Total B. F004((Tuition Fee)	25,300	25,300	27,940	27,940	31,240	31,240	33,000	33,000	45,650
C. F005(Library Fee/Lab/IT)	2,090	2,090	2,200	2,200	2,420	2,420	2,660	2,660	
F006(Examination Fee)	2,090	2,090	2,200	2,200	2,420	2,420	2,660	2,660	
F007 (Sports Fee)	660	660	770	770	845	845	930	930	
F011(Transcript Fee)	-	-	-	-	-	-	-	1,300	
F012 (Endowment Fund)	770	770	850	850	935	935	1030	1030	
F013(Development charges)	660	660	730	730	800	800	880	880	
F014(Thesis/Report Writing)	-	-	-	-	-	-	-	1,200	
F015 (Transport Fee)	880	880	970	970	1070	1070	1175	1175	
F016 (Student's Guardian Indemnity)	550	550	600	600	660	660	725	725	
Sub-Total C:	7,700	7,700	8,320	8,320	9,150	9,150	10,151	12,650	
Grand Total (A+B+C)	44,330	33,000	36,260	36,260	40,390	40,390	43,150	45,650	

*** Students applying for admission in 5th Semester (Lateral Entry) will pay admission fee (F001), Registration Fee (F002) and Security (F003) along with total semester fee in 5th semester.**

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Registrar office
(General section)

Date: 09-05-2024

Notification:

No.WUB/ARO/ (G)/1877-85/2024. On the recommendations of University Fee and Funds Committee, the Vice Chancellor, Subject to the approval of the Academics Council and Senate has been pleased to approve the following revised rates of fee and fund for admission in BS Emergency Medical Technology, BS Clinical Laboratory Science, BS Diagnostic Radiology & Imaging Technology, BS Surgical & Operation Theater Sciences and BS Dental Technology Faculty of Medicine Pharmacy& Dentistry (Four Years Duration) for Academic Session fall 2024 and onward.

BS Emergency Medical Technology, BS Clinical Laboratory Science, BS Diagnostic Radiology & Imaging Technology, BS Surgical & Operation Theater Sciences and BS Dental Technology and Equivalent									
Fee Codes	**1st Semester**	**2nd Semester**	**3rd Semester**	**4th Semester**	**5th Semester**	**6th Semester**	**7th Semester**	**8th Semester**	
A. F001(Admission Fee	5,280	-	-	-	-	-	-	-	
F002(Registration Fee)	2,750	-	-	-	-	-	-	-	**9th Semester and onward (if applicable)**
F003((Security Fee) (Refundable)	3,300	-	-	-	-	-	-	-	
Sub. Total. A.	**11,330**	-	-	-	-	-	-	-	
Sub. Total B: F004((Tuition Fee)	38,500	38,500	40,700	40,700	43,890	43,890	46,200	46,200	
C. F005(Library Fee/Lab/IT)	4,400	4,400	4,840	4,840	5,320	5,320	5,850	5,850	
F006(Examination Fee)	2,090	2,090	2,200	2,200	2,420	2,420	2,660	2,660	
F007(Sports Fee)	660	660	770	770	845	845	930	930	
F011(Transcript Fee)	-	-	-	-	-	-	-	1,300	
F012 (Endowment Fund)	770	770	850	850	935	935	1030	1030	**61,850**
F013(Development charges)	660	660	730	730	800	800	880	880	
F014(Thesis/Report Writing)	-	-	-	-	-	-	-	1,100	
F015 (Transport Fee)	880	880	970	970	1070	1070	1175	1175	
F016 (Student's Guardian Indemnity)	550	550	600	600	660	660	725	725	
Sub-Total C:	**10,010**	**10,010**	**10,960**	**10,960**	**12,050**	**12,050**	**13,250**	**15,650**	
Grand Total (A+B+C)	***59,840***	***48,510***	***51,660***	***51,660***	***55,940***	***55,940***	***59,450***	***61,850***	
*** Students applying for admission in 5th Semester (Lateral Entry) will pay admission fee (F001), Registration Fee (F002) and Security (F003) along with total semester fee in 5th semester.**									

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Fee Structure Pharmacy

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Registrar office
(General section)

Date: 09-05-2024

Notification:

No.WUB/ARO/ (G)/1886-94/2024. On the recommendations of University Fee and Funds Committee, the Vice Chancellor, Subject to the approval of the Academics Council and Senate has been pleased to approve the following rates of fee and fund for admission in BS Pharmacy (five Years Duration) in Faculty of Medicine Pharmacy & Dentistry for Academic Session 2024 and onward.

Fee Codes	1st Semester	2nd Semester	3rd Semester	4th Semester	5th Semester	6th Semester	7th Semester	8th Semester	9th	10th
A.F001(Admission Fee	5280	-	-	-	-	-	-	-	-	-
F002(Registration Fee)	2750	-	-	-	-	-	-	-	-	-
F003((Security Fee) (Refundable)	3300	-	-	-	-	-	-	-	-	-
Sub. Total. A.	11,330	-	-	-	-	-	-	-	-	-
Sub Total B. F004((Tuition Fee)	55,000	55,000	60,000	60,000	65,000	65,000	70,500	70,500	77,550	77,550
C.F005(Library Fee/Lab/IT)	4400	4400	4840	4840	5320	5320	5850	5850	6,460	6,460
F006(Examination Fee)	2090	2090	2200	2200	2420	2420	2660	2660	2,930	2,930
F007(Sports Fee)	660	660	770	770	845	845	930	930	1,020	1,020
F011(Transcript Fee)	-	-	-	-	-	-	-	-		1,300
F012 (Endowment Fund)	770	770	850	850	935	935	1030	1030	1,130	1,130
F013(Development charges)	660	660	730	730	800	800	880	880	970	970
F014(Thesis/Report Writing)	-	-	-	-	-	-	-	-	1200	1200
F015 (Transport Fee)	880	880	970	970	1070	1070	1175	1175	1300	1,300
F016 (Student's Guardian Indemnity)	550	550	600	600	660	660	725	725	1300	1,300
Sub-Total C:	10,010	10,010	10,960	10,960	12,050	12,050	13,250	13,250	16,310	17,610
Total (A+B+C)	76,340	65,010	70,960	70,960	77,050	77,050	83,750	83,750	93,860	95,160
Non-Subsidized/ Self Students will pay additional Tuition Fee	30,000	30,000	33,000	33,000	36,000	36,000	39,000	39,000	42,000	42,000
G. Total	106,340	95,010	103,960	103,960	113,050	113,050	122,750	122,750	135,860	137,160

Assistant Registrar
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Low temperature synthesis of franklinite stabilized cefixime as a multifunctional nanoformulation

Amna Munsaf,[ab] Muhammad Naeem Ahmed,[*a] Aroosa Zafar,[c] Bilal Akram[*bd] and Mahmoud A. A. Ibrahim[ef]

Cefixime, an antibiotic with low solubility, stability, bioavailability and therapeutic effectiveness, needs to be administered in larger doses for effective treatment. This can lead to higher healthcare costs and increased risk of side effects, negatively affecting public health. Herein, we aim to develop a strategy to overcome the aforementioned limitations by stabilizing it using franklinite nanostructures. Franklinite nanostructures ($ZnFe_2O_4$) were synthesized *via* a green method and subsequently used as a support to stabilize cefixime (Cef). The successful formation of $ZnFe_2O_4$ nanostructures and subsequent loading of the drug was confirmed using various microscopic and spectroscopic analyses. Solubility measurements and dissolution tests for the franklinite stabilized cefixime (Cef–$ZnFe_2O_4$) indicated increased solubility, enhanced *in vitro* bioavailability and greater absorption under physiological conditions. Hemolytic assay affirmed the safety and efficacy of drug stabilized by franklinite. Biological assessment of Cef–$ZnFe_2O_4$ revealed that it has strong antifungal, antioxidant and kinase inhibition potential as compared to its bare counterpart. These findings emphasize the potential of newly designed Cef–$ZnFe_2O_4$ as a promising nanoformulation with enhanced solubility, efficacy, safety and biological activities.

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Introduction

Traditional medications, despite their clinical applications, often face limitations in optimizing their therapeutic efficacy while minimizing associated side effects. These limitations include low bioavailability, less solubility and emergence of antimicrobial resistance. These issues demand high drug doses to achieve the desired effect, leading to increased side effects, reduced adherence and rapid excretion from the body.[1,2] Cefixime is a broad-spectrum cephalosporin antibiotic characterized by poor solubility and instability under certain conditions. These properties restrict its absorption in the gastrointestinal tract and consequently diminish its therapeutic effectiveness.[3,4] Furthermore, these limitations can result in less-than-ideal therapeutic outcomes and contribute to the development of antibiotic resistance.

To address these concerns, nanotechnology has opened a path to advanced treatment strategies through nanomedicines.[5] The scientific community has been recently showing increasing interest in nanomaterials owing to the combined physicochemical characteristics of their constituent parts.[6–8] These nanomaterials hold significant importance across various scientific and technological fields, including optics, electronics, environmental science, aerospace[9,10] and medicine, due to their diverse applications, which are influenced by their structures, compositions and stabilities.[11,12] Metal oxide-based nanomaterials, owing to their inherent properties, have been reported as promising solutions for addressing a range of ailments, including microbial infections,[13] inflammations,[14] malignancies[15] and liver disorders.[16–20] Due to their biocompatibility, chemical stability, ease of separation and cost-effectiveness, they are ideal for biomedical applications.[21–23] By incorporating therapeutic agents into nanoscale matrices, nanomaterials offer several advantages, including increased drug stability, solubility, bioavailability and efficacy.[24–28]

Transition metal ferrites possess versatile characteristics, such as high surface area, high chemical stability, high surface active sites, strong magnetic properties and ease of functionalization. These properties make them key components in a wide range of industrial and technological applications.[29] Franklinite, in particular, offers a unique combination of properties. The presence of both Fe and Zn atoms enhances the stability of franklinite nanostructures and imparts bi-functional

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Research Article

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Exploring the antimicrobial potential of biogenically synthesized graphene oxide nanoparticles against targeted bacterial and fungal pathogens

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Abstract: Graphene oxide (GO) and reduced graphene oxide (rGO) nanoparticles were synthesized using 40 mL of lemon juice extract as a reducing agent. The synthesized nanoparticles were characterized using various analytical techniques, including UV–visible spectroscopy, scanning electron microscopy, energy-dispersive X-ray spectroscopy, Fourier transform infrared spectroscopy, and X-ray diffraction. The results confirmed the successful synthesis of GO and rGO nanoparticles with varied sizes and shapes. The synthesized nanoparticles were tested for their antimicrobial activity against a range of bacterial and fungal strains, including *Escherichia coli, Staphylococcus aureus*, *Klebsiella pneumoniae, Candida albicans, Fusarium oxysporum,* and *Aspergillus flavus*. Multiple concentrations of GO and rGO nanoparticles were tested, and it was observed that 100 $\mu g \cdot mL^{-1}$ of both GO and rGO showed the highest inhibitory effect against bacterial and produced zones of inhibition of 17.66 mm, 18.67 mm, and 17.88 for *E. coli, S. aureus*, *K. pneumoniae* and 20.33, 22.45, and 21.34 mm for *C. albicans, F. oxysporum,* and *A. flavus*. Comparatively, GO performed well as compared to rGO regarding antimicrobial activity. The synthesized nanoparticles exhibited significant antimicrobial activity against various bacterial and fungal strains and have the potential to be developed as novel antimicrobial agents.

Keywords: nanotechnology, green method, antimicrobial potential, graphene oxide nanoparticles

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1 Introduction

In the current era, nanotechnology has a wide range of applications, producing tiny nanoparticles with diameters between 1 and 100 nm, which are crucial for the treatment of many diseases [1–3]. Due to their large surface-to-volume ratio and high surface energies, these particles have a variety of biomedical purposes [4,5]. Nanoparticles (NPs) are among the most frequently produced and used

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BMC Plant Biology

RESEARCH Open Ac

Green-fabricated silver nanoparticles from *Quercus incana* leaf extract to control the early blight of tomatoes caused by *Alternaria solani*

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Abstract

Background Early blight (EB) of Tomatoes, caused by *Alternaria solani*, is a serious fungal disease that adversely affects tomato production. Infection is characterized by dark lesions on leaves, stems, and fruits. Several agrochemicals can be used to control infection, these chemicals may disrupt environmental equilibrium. An alternative technology is needed to address this significant fungal threat. This study was designed to control the growth of EB in tomatoes caused by *A. solani*, using green-fabricated silver nanoparticles (Ag-NPs).

Results Ag-NPs were synthesized through an environmentally friendly and cost-effective approach using leaf extract of *Quercus incana* Roxb. (*Fagaceae*). The physico-chemical characterization of the Ag-NPs was conducted through UV-visible spectroscopy, scanning electron microscopy, X-ray diffraction analysis, and Fourier transform infrared spectrometry. The Ag-NPs produced were round with a mean diameter of 27 nm. The antifungal activity of these Ag-NPs was assessed through in vitro Petri plate and in vitro leaflet assays against *A. solani*. The green fabricated Ag-NPs exhibited excellent antifungal activity in vitro at a concentration of 100 mg/l against *A. solani*, inhibiting growth by 98.27 ± 1.58% and 92.79 ± 1.33% during Petri plate and leaflet assays, respectively.

Conclusion In conclusion, this study suggests the practical application of green-fabricated Ag-NPs from *Q. incana* leaf extract against *A. solani* to effectively control EB disease in tomatoes.

Keywords Silver nanoparticles, Green fabrication, Antifungal, *Alternaria solani*, Early blight of tomatoes

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PeerJ Computer Science

The role of Internet of Things (IoT) technology in modern cultivation for the implementation of greenhouses

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ABSTRACT

In recent years, the Internet of Things (IoT) has become one of the most familiar names creating a benchmark and scaling new heights. IoT an indeed future of the communication that has transformed the objects (things) of the real world into smarter devices. With the advent of IoT technology, this decade is witnessing a transformation from traditional agriculture approaches to the most advanced ones. Limited research has been carried out in this direction. Thus, herein we present various technological aspects involved in IoT-based cultivation. The role and the key components of smart farming using IoT were examined, with a focus on network technologies, including layers, protocols, topologies, network architecture, *etc.* We also delve into the integration of relevant technologies such as cloud computing, big data analytics, and the integration of IoT-based cultivation. We explored various security issues in modern IoT cultivation and also emphasized the importance of safeguarding sensitive agricultural data. Additionally, a comprehensive list of applications based on sensors and mobile devices is provided, offering refined solutions for greenhouse management. The principles and regulations established by different countries for IoT-based cultivation systems are presented, demonstrating the global recognition of these technologies. Furthermore, a selection of successful use cases and real-world scenarios and applications were presented. Finally, the open research challenges and solutions in modern IoT-based cultivation were discussed.

Subjects Artificial Intelligence, World Wide Web and Web Science, Internet Of Things
Keywords Internet of things, Big data, Security, Technologies

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RESEARCH ARTICLE

Numerical Scheme for the Computational Study of Two Dimensional Diffusion and Burgers' Systems with Stability and Error Estimate

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Abstract

This paper demonstrates a numerical stratagem for the solution of two dimensional single and coupled partial differential equations, using the new version of the Haar wavelets namely: the scale-3 Haar wavelets (S3HW), combined with the finite difference formulation. The proposed method consists of two phases. The first phase deals with the numerical estimation of the temporal derivative via finite difference which converts the problem to time discrete form. The second phase describes, the approximation of the spatial derivatives along with solution, adopting S3HW. Then, the collocation technique is implemented to transform the resultant system to the set of linear algebraic equations. Solution of the linear system gives the unknown wavelet coefficients which utilized to determine the numerical solutions. Afterwards, the error, convergence, and stability analysis are conducted and deduced a new error estimate. Besides, the numerical simulations are done to verify the scheme and the obtained theoretical findings (convergence and stability). To validate, the performance of the present scheme different error measures $\mathcal{L}_\infty$, $\mathcal{L}_2$, root mean square (RMS), and relative error (RE) are determined numerically. The scheme is also compared in terms of error with the scale-2 Haar wavelets and radial basis functions based algorithms. Overall judgement shows, that the numerical results of the developed scheme are in good agreement with the exact solution and the aforementioned methods in the literature.

Keywords Nonlinear PDEs · Scale-3 Haar wavelet · Finite difference formulation · Convergence and stability

Extended author information available on the last page of the article

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Dynamics of the time-fractional reaction–diffusion coupled equations in biological and chemical processes

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This paper aims to demonstrate a numerical strategy via finite difference formulations for time fractional reaction–diffusion models which are ubiquitous in chemical and biological phenomena. The time-fractional derivative is considered in the Caputo sense for both linear and nonlinear problems. First, the Caputo derivative is replaced with a quadrature formula, then an implicit method is used for the remaining part. In the linear case, the proposed strategy reduces the time fractional models into linear simultaneous equations. In nonlinear cases, Quasilinearization is utilized to tackle the nonlinear parts. With this strategy, solutions of the fractional system transform into linear algebraic systems which are easy to solve. Next, the Von Neumann method is implemented to examine the stability of the scheme which discloses that the scheme is unconditionally stable. Further, the applicability of the presented scheme is tested with different linear and nonlinear models which include the one dimensional Schnakenberg and Gray–Scott models, and one and two dimensional Brusselator models. To analyze the accuracy of the present technique two norms namely, $\mathbb{L}_\infty$ and $\mathbb{L}_2$, and relative error are addressed. Moreover, the obtained outcomes are shown tabulated and graphically which identifies that the scheme properly works for the time fractional reaction–diffusion systems.

Keywords Fractional calculus, Implicit scheme, Caputo fractional derivative, Brusselator model, Schnakenberg model, Gray–Scott model, Stability analysis

Reaction–diffusion models (RDMs) play a vital role in describing various spatial patterns like mazes, stripes, and spots through chemical operations in cells. RDMs theory has been started from the pioneer work of Turing[1] which explored the importance of pattern formation via RDMs and biological processes. Particularly, this theory describes that uniform stability of the system remains in the absence of diffusion parameters while different spatial pattern formations can be realized in the presence of reaction and diffusion. Many authors identified the usage of RDMs models in various scientific and engineering disciplines. For example pattern formation in hydra[2], shell pigmentation[3], animal coat markings[4] and many other for which the readers may refer to see[5]. The aforementioned applications show that RDMs are ubiquitous in different areas of science.

RDMs are highly non-linear and its closed form solution is a challenging task. Therefore, numerical techniques are the alternative remedies to capture the dynamics of non-linear models. Several computational strategies have been advised in the literature to determine the numerical solutions of non-linear RDMs related to pattern formation. For example, Ersoy[6] established a computational algorithm for the study of RDMs using an exponential cubic B-spline. Onarcan et al.[7] proposed a numerical based on trigonometric cubic B-spline to solve RDMs. Similarly, finite difference-based techniques[8,9] and finite element method[10] have been used to solve the RDMs. Mittal and his co-author developed solved RDMs by modified cubic B-spline coupled with differential quadrature. Korkmaz et al.[11] investigated the motion of different patterns modeled by a special case of RDMs.

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Integrated geophysical and geospatial techniques for surface and groundwater modeling

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An integrated approach using geophysical and geospatial techniques was employed to model the surface and subsurface water-bearing strata and assess aquifer vulnerability in the Sehnsa town, Kotli district, State of Azad Kashmir, Pakistan. The inadequate scientific studies in the hilly terrain with such complex geological conditions has led to the failure of the boreholes for groundwater extraction. For the evaluation of groundwater potential and subsurface lithology, 30 vertical electrical soundings (VES) stations utilizing the Schlumberger electrode configuration were completed, modeled and analyzed spatially. Numerous geoelectrical parameters like true resistivity, thickness of subsurface layers and Dar-Zarrouk parameters were evaluated. The subsurface lithology delineated comprised topsoil, clayey sand, sandstone, and boulder clays which closely resemble to the borehole lithologs available in the study area. The inversion model confirms the presence of patches of high-resistivity sandstone in the southwestern part of the study area with the maximum thickness of the aquifer up to 140 m. Most aquifers were classified as unconfined with Q–type resistivity curves. The protective overburden capacity of the aquifers is rated as poor at VES 1, 3–5, 8, 10–16, 18, 19, 22–25, 27 and 30 whereas the moderate category was found at VES 2, 9 and 20 and excellent at VES 7 and 28, respectively. Therefore, the VES stations with poor and moderate ratings of overburden protective capacity are vulnerable for surface contaminants. The aquifer recharge was associated with rainfall and partly from the Poonch River. The effective integration of geophysical and geospatial techniques in this study provides sufficient information about the regional water resources and gives a preliminary model that can facilitate efficient water resource management in the area. These approaches can be successfully applied to diverse geographical and hydrogeological sites due to their versatility and reliability.

Keywords Groundwater potential, Schlumberger, Geospatial, Surface water, Vulnerability, Vertical electrical sounding

Water plays a vital role in the life of every living organism[1]; with the increase in population and urbanization requirement for safe water resources is increasing; additionally, high extraction has put subsurface as well as surface water resources under immense pressure[1–4]. With increased demand, efforts have been put in to map the water distribution. Another growing problem is the deterioration of the underlying aquifer system due to excessive pumping and contaminant infiltration. It is an essential part of the groundwater surveys to delineate the surficial areas which can lead to the cause of groundwater or aquifer contamination[2,5–7]. Many conventional and non-conventional methods have been used worldwide to map water-bearing zones and for aquifer vulnerability assessment. The vertical electrical sounding (VES) method has been proven to be the best reliable solution for groundwater-related issues including exploration and vulnerability assessment[8–13]. The VES method has been widely used for groundwater extraction in fissured and permeable media channels[14,15]. The apparent resistivity field data acquired by VES generates pseudo-section plots by contouring. The pseudo section is helpful in showing the apparent resistivity values in a pictorial frame and as an underlying aide for further quantitative elucidation[16–18]. The vertical electrical sounding technique is considered to be a low-cost alternative for groundwater potential mapping in any region[19–21].

The integration of Geographic Information System (GIS) and Geoelectrical techniques have been used for the aquifers study and well site selection. Moreover, these are proven low-cost techniques for underground

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First principle study of scandium-based novel ternary half Heusler ScXGe (X = Mn and Fe) alloys: insight into the spin-polarized structural, electronic, and magnetic properties†

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The structural, electronic, and magnetic properties of novel half-Heusler alloys ScXGe (X = Mn, Fe) are investigated using the first principle full potential linearized augmented plane wave approach based on density functional theory (DFT). To attain the desired outcomes, we employed the exchange–correlation frameworks, specifically the local density approximation in combination with Perdew, Burke, and Ernzerhof's generalized gradient approximation plus the Hubbard *U* parameter method (GGA + *U*) to highlight the strong exchange–correlation interaction in these alloys. The structural parameter optimizations, whether ferromagnetic (FM) or nonmagnetic (NM), reveal that all ScXGe (where X = Mn, Fe) Heusler alloys attain their lowest ground state energy during FM optimization. The examination of the electronic properties of these alloys reveals their metallic character in both the spin-up and spin-down channels. The projected densities of states indicate that bonding is achieved through the hybridization of p–d and d–d states in all of the compounds. The investigation of the magnetic properties in ScXGe (where X = Mn, Fe) compounds indicates pronounced stability in their ferromagnetic state. Notably, the Curie temperatures for ScXGe (X = Mn, Fe) are determined to be 2177.02 K and 1656.09 K, respectively. The observation of metallic behavior and the strong ferromagnetic characteristics in ScXGe (X = Mn, Fe) half-Heusler alloys underscores their potential significance in the realm of spintronic devices. Consequently, our study serves as a robust foundation for subsequent experimental validation.

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1. Introduction

Heusler alloys, originally conceived by Friedrich Heusler in 1903,[1] have recently garnered significant attention within the scientific community due to their promising potential in the realm of spintronics and smart materials.[2] Among these alloys, Half-Heusler (HH) semiconductors stand out, characterized by having either eight (08) or eighteen (18) valence electrons and band gaps spanning from 0 to 4 eV. Remarkably, this category encompasses around 250 ternary compounds. Recent research reports have also revealed a multitude of physical phenomena associated with these Heusler alloys, including ferroelectricity, ferromagnetism, and ferroelasticity, attributed largely to their multifunctional properties. As a result, these alloys are continually drawing significant interest in a wide range of fields, including spintronics,[3,4] optoelectronics (such as sensors, magnetoresistors, photovoltaic detectors, and light-emitting diodes), thermoelectronics,[5,6] shape memory applications,[2,7] piezoelectric semiconductors,[3,8] topological insulators,[4,9] and superconductivity.[10,11] Additionally, they offer distinct advantages over conventional electronic devices based on standard semiconductors, owing to the added spin degree of freedom, resulting in benefits such as enhanced data processing speed, increased integration densities, and reduced power consumption.[12–14] Moreover, the pursuit of achieving fully spin-polarized currents has generated considerable interest in these materials.[15] Heusler alloys possess another remarkable feature, stemming from their utilization of cost-effective raw materials and their ability to withstand chemical and mechanical stresses at high temperatures and densities. In the realm of thermoelectric applications, Heusler alloys have been subject to

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Botanical Studies

ORIGINAL ARTICLE Open Ac

Antibacterial, antioxidant, and anticancer potential of green fabricated silver nanoparticles made from *Viburnum grandiflorum* leaf extract

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Abstract

Background Recently, researchers are focusing on creating new tools to combat the antibiotic resistant bacteria and malignancy issues, which pose significant threats to humanity. Biosynthesized silver nanoparticles (AgNPs) are thought to be a potential solution to these issues. The biosynthesis method, known for its environmentally friendly and cost-effective characteristics, can produce small-sized AgNPs with antimicrobial and anticancer properties. In this study, AgNPs were bio-fabricated from the distilled water and methanolic extracts of *Viburnum grandiflorum* leaves. Physio-chemical characterization of the bio-fabricated AgNPs was conducted using UV-visible spectroscopy, scanning electron microscopy, energy dispersive X-ray, and X-ray diffraction analysis.

Results AgNPs produced from the methanol extract were smaller in size (12.28 nm) compared to those from the aqueous extract (17.77 nm). The bioengineered AgNPs exhibited a circular shape with a crystalline nature. These biosynthesized AgNPs demonstrated excellent bactericidal activity against both gram-negative (*Pseudomonas aeruginosa*) and gram-positive (*Staphylococcus aureus*) bacteria. Highest antibacterial activity was observed with the methanol extract against *P. aeruginosa* (14.66 ± 0.74 mm). AgNPs from the methanol extract also displayed the highest antioxidant activity, with an IC_{50} value of 188.00 ± 2.67 µg/mL against 2,2-diphenyl-1-picrylhydrazyl (DPPH). Furthermore, AgNPs exhibited notable cytotoxic activity against Rhabdomyosarcoma cell line (RD cell) of human muscle cancer cell. The IC_{50} values calculated from the MTT assay were 26.28 ± 1.58 and 21.49 ± 1.44 µg/mL for AgNPs synthesized from aqueous and methanol extracts, respectively.

Conclusion The methanol extract of *V. grandiflorum* leaves demonstrates significant potential for synthesizing AgNPs with effective antibacterial, antioxidant, and anticancer actions, making them applicable in various biomedical applications.

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Journal of Ethnobiology and Ethnomedicine

RESEARCH

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Foraging for the future: traditional culinary uses of wild plants in the Western Himalayas–Kashmir Valley (India)

Musheerul Hassan[1,2], Tawseef Ahmad Mir[3,4,5], Muatasim Jan[3,4,5], Muhammad Shoaib Amjad[6,7*], Muhammad Abdul Aziz[8,9], Andrea Pieroni[9,10], Ivana Vitasović-Kosić[11] and Rainer W. Bussmann[1,12]

Abstract

Background In the intricate tapestry of food security, wild food species stand as pillars, nourishing millions in low-income communities, and reflecting the resilience and adaptability of human societies. Their significance extends beyond mere sustenance, intertwining with cultural traditions and local knowledge systems, underscoring the importance of preserving biodiversity and traditional practices for sustainable livelihoods.

Methods The present study, conducted between February 2022 and August 2023 along the Line of Control in India's Kashmir Valley, employed a rigorous data collection encompassing semi-structured interviews, focus group discussions, and specific field observations facilitated through a snowball sampling technique.

Results and discussion The comprehensive inventory includes 108 edible plant and fungal species from 48 taxonomic families, with Rosaceae (*N* = 11) standing out. Young and soft leaves (N = 60) are an important component of various culinary preparations, with vegetables (*N* = 65) being the main use, followed by fruits (*N* = 19). This use is seasonal, with collection peaks in March–April and June–August (*N* = 12). The study also highlights the importance of use value (UV), with *Portulaca oleracea* standing out as the plant taxon (UV = 0.61), while *Asyneuma thomsoni* has the lowest use value (UV = 0.15). Many species such as *Senecio chrysanthemoides, Asperugo procumbens, Asyneuma thomsoni,* and *Potentilla nepalensis* were classified as new for gastronomic use. Furthermore, the study underlines the great cultural importance of mushrooms such as *Morchella esculenta* and *Geopora arenicola* in influencing social hierarchies within the community. However, the transmission of traditional knowledge across generations is declining in the region. At the same time, the conservation of endangered plant species on the IUCN Red List, such as *Trillium govanianum, Taxus wallichiana, Saussurea costus,* and *Podophyllum hexandrum*, requires immediate attention.

Conclusion Conservation measures should be prioritized, and proactive remedial action is needed. Further research into the nutritional value of these edible species could pave the way for their commercial cultivation, which would mean potential economic growth for local communities, make an important contribution to food security in the area under study, and contribute to scientific progress.

Keywords Wild vegetable, Traditional knowledge, Ethno-gastronomy, Kashmir Valley, Edible fungi

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molecules

MDPI

Correction

Correction: Sarwer et al. Green Synthesis and Characterization of Silver Nanoparticles Using *Myrsine africana* Leaf Extract for Their Antibacterial, Antioxidant and Phytotoxic Activities. *Molecules* 2022, *27*, 7612

Qudsia Sarwer [1], Muhammad Shoaib Amjad [1,2,*], Ansar Mehmood [3], Zakia Binish [1], Ghazala Mustafa [4], Atikah Farooq [4], Mirza Faisal Qaseem [5], Fozia Abasi [6] and José Manuel Pérez de la Lastra [7,*]

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The authors wish to make the following corrections to this paper [1]. The authors state that the scientific conclusions are unaffected. This correction was approved by the Academic Editor. The original publication has also been updated.

2. Material and Methods

2.1. Collection of Sample and Preparation of Plant Extract

In the original publication, some information about the plant material and the collection date was missing. The correct information appears below.

The leaves of *M. africana* were collected by Qudsia Sarwer from Kahutta Azad Jammu and Kashmir in April 2021. The plant was identified by Dr. Muhammad Shoaib Amjad with the help of Flora of Pakistan and a voucher specimen (voucher number 278) was deposited in the Herbarium of the Department of Botany, Women University of Azad Jammu and Kashmir Bagh (Section 2.1).

2.4. Biological Activities

2.4.1. Antibacterial Activity

In the original publication, the information of the number of bacterial strains is incorrect. The correct information appears below.

Four putative bacterial pathogens, *Pseudomonas aeruginosa*, *Escherichia coli*, *Staphylococcus aurous* and *Klebsiella pneumoniae*, were used for antibacterial activity.

Figure 1

In the original publication, the reference to the origin of the *Myrsine africana* picture was missing. It is now cited in the figure legend as follows:

The image of *M. africana* used in this figure can be found on Wikipedia (https://en.wikipedia.org/wiki/Myrsine_africana), last accessed on 17 September 2022.

check for updates

Citation: Sarwer, Q.; Amjad, M.S.; Mehmood, A.; Binish, Z.; Mustafa, G.; Farooq, A.; Qaseem, M.F.; Abasi, F.; Lastra, J.M.P.d.l. Correction: Sarwer et al. Green Synthesis and Characterization of Silver Nanoparticles Using *Myrsine africana* Leaf Extract for Their Antibacterial, Antioxidant and Phytotoxic Activities. *Molecules* 2022, *27*, 7612. *Molecules* **2024**, *29*, 1922. https://doi.org/10.3390/molecules29091922

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nature climate change

Article

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Enhanced woody biomass production in a mature temperate forest under elevated CO_2

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Check for updates

Richard J. Norby[1,2,3] ✉, Neil J. Loader[4], Carolina Mayoral[1,5], Sami Ullah[1,2], Giulio Curioni[1,10], Andy R. Smith[6], Michaela K. Reay[1,2,11], Klaske van Wijngaarden[1,2,7], Muhammad Shoaib Amjad[1,12], Deanne Brettle[1,2], Martha E. Crockatt[8,13], Gael Denny[1], Robert T. Grzesik[1,2], R. Liz Hamilton[1,2], Kris M. Hart[1], Iain P. Hartley[9], Alan G. Jones[8,14], Angeliki Kourmouli[1,2,15], Joshua R. Larsen[1,2], Zongbo Shi[1,2], Rick M. Thomas[1,2,16] & A. Robert MacKenzie[1,2] ✉

Enhanced CO_2 assimilation by forests as atmospheric CO_2 concentration rises could slow the rate of CO_2 increase if the assimilated carbon is allocated to long-lived biomass. Experiments in young tree plantations support a CO_2 fertilization effect as atmospheric CO_2 continues to increase. Uncertainty exists, however, as to whether older, more mature forests retain the capacity to respond to elevated CO_2. Here, aided by tree-ring analysis and canopy laser scanning, we show that a 180-year-old *Quercus robur* L. woodland in central England increased the production of woody biomass when exposed to free-air CO_2 enrichment (FACE) for 7 years. Further, elevated CO_2 increased exudation of carbon from fine roots into the soil with likely effects on nutrient cycles. The increase in tree growth and allocation to long-lived woody biomass demonstrated here substantiates the major role for mature temperate forests in climate change mitigation.

Carbon uptake and storage by terrestrial vegetation is a major source of uncertainty in projections of future levels of CO_2 in the atmosphere and the resulting effects on climate[1,2]. Multiple lines of evidence indicate that increasing atmospheric CO_2 concentration in recent decades resulting from anthropogenic emissions and land use change have led to higher rates of CO_2 uptake by plants, that is, the CO_2 fertilization effect, including in forests, which dominate the terrestrial C cycle[3,4]. Evidence for forest responses to the atmospheric CO_2 concentrations that will be attained in future decades comes from a limited number of decade-long free-air CO_2 enrichment (FACE) experiments in which forest plots were exposed to elevated CO_2 (eCO_2). These 'first generation' forest FACE experiments[5–7] were established in young tree plantations, and questions arise as to the extent to which their responses to eCO_2, including increased growth and primary productivity, are predictive of the responses of older, more established forests[8–10]. There are multiple issues to consider. As forests develop over time, nitrogen, which is often the limiting resource in unmanaged temperate stands, becomes increasingly sequestered in wood or recalcitrant soil organic matter

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Original Article

Phytochemical screening, antimicrobial activity, *in vitro* and *in vivo* antioxidant activity of *Berberis lycium* Royle root bark extract

Triagem fitoquímica, atividade antimicrobiana, atividade antioxidante *in vitro* e *in vivo* do extrato de casca de raiz de *Berberis lycium* Royle

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Abstract

Antioxidants are materials that scavenge or remove free radicals from living systems. The oxidation process ends in the production of free radicals. These free radicals are the chief birthplace of cancerous cells. Antioxidizing agents remove free radical intermediates by terminating oxidation processes by being oxidized themselves. On the other hand, infectious diseases affect the world on a large scale. To fight these diseases several synthetic compounds have been used. Plant based medications play important role in this regard. So, the current research aimed to investigate the antibacterial and antioxidant effect of *Berberis lycium* Royle root bark (BLR) extract. *Berberis lycium* Royle was used for phytochemical analysis and also as antimicrobial and antioxidant agents. The antimicrobial activity was evaluated by the agar well diffusion method. Current study revealed that BLR was rich in phytochemicals and toxic against tested pathogenic bacteria. BLR showed the highest activity against *S. pyogenes* (13.3±0.8 mm). The lowest antibacterial activity was reported against *E. coli* (0±0 mm). In case of minimum inhibitory concentration, it was observed that BLR with 10 µg/mL concentration showed the highest activity while 2.5 µg/mL of BLR showed the least inhibitory activity. The highest *In vitro* antioxidant activity was recorded as 65% at 100 µg/mL. In case of *in vivo* antioxidant activity level of CAT, GSH and SOD were decreased while that of MDA was enhanced in groups treated with CCl_4 as compared to the control group. BLR extract treatment reversed all these changes significantly. Current results indicate that BLR is effective against bacterial pathogens and also has antioxidant potential.

Keywords: *Berberis lycium* Royle, root bark extract, phytochemicals, antibacterial, antioxidant.

Resumo

Os antioxidantes são materiais que eliminam ou removem os radicais livres dos sistemas vivos. O processo de oxidação termina na produção de radicais livres. Esses radicais livres são o principal local de nascimento das células cancerosas. Os agentes antioxidantes removem os intermediários dos radicais livres ao encerrar os processos de oxidação ao serem eles próprios oxidados. Por outro lado, as doenças infecciosas afetam o mundo em grande escala. Para combater essas doenças, diversos compostos sintéticos têm sido utilizados. Os medicamentos à base de plantas desempenham um papel importante a este respeito. Assim, o objetivo da pesquisa atual é investigar o efeito antibacteriano e antioxidante do extrato da casca da raiz de *Berberis lycium* Royle (BLR). *Berberis lycium* Royle foi utilizado para análises fitoquímicas e também como agentes antimicrobianos e antioxidantes. A atividade antimicrobiana foi avaliada pelo método de difusão em ágar em poço. A partir do estudo atual, observou-se que o BLR era rico em fitoquímicos e tóxico contra bactérias patogênicas testadas. BLR apresentou maior atividade contra *S. pyogenes* (13,3 ± 0,8 mm). A menor atividade antibacteriana foi relatada contra *E. coli* (0 ± 0 mm). No caso de concentração inibitória mínima, observou-se que BLR com concentração de 10 µg / mL apresentou maior

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Original Article

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A Novel Missense Variant in the *CHST3* Underlies Spondyloepiphyseal Dysplasia with Congenital Joint Dislocations

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Keywords
Spondyloepiphyseal dysplasia with congenital joint dislocations · Exome sequencing · Sanger sequencing · *CHST3* · Novel variant

Abstract
Background: Spondyloepiphyseal dysplasia (SED) is characterized by skeletal dysplasia and multiple joint dislocations. SEDs encompass various types, such as SED congenita, SED tarda (SED-T), SED with congenital joint dislocations (SED-CJD), SED stanescu, and SED-T with progressive arthropathy. ***Methods and Results:*** In the present study, we clinically and genetically characterized a consanguineous Pakistani family with SED-CJD. The affected member showed large joint dislocation, spinal deformities, and previously unreported facial features. Exome sequencing followed by Sanger sequencing revealed a missense variant, [c.601T>A; p.(Tyr201Asn)], in the *CHST3*. ***Conclusion:*** This study has not only expended the mutation spectrum in the gene *CHST3* but also will facilitate diagnosis and genetic counseling of related features in the Pakistani population.

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Introduction

Spondyloepiphyseal dysplasia (SED) with congenital joint dislocations (OMIM #143095) represents a distinctive type of skeletal dysplasia. It is distinguished by severe short stature, malformed and dislocated joints, along with progressive kyphosis. The cardinal features of the condition are dislocations of the hip, knee, and elbow joints, with equinovarus or equinovalgus foot deformities. Craniofacial anomalies include hypertelorism, prominence of the forehead, a depressed nasal bridge, and a flattened midface. Cleft palate and short stature are often associated features. Spinal anomalies include scoliosis and cervical kyphosis [1, 2].

SEDs are a group of hereditary skeletal deformities, primarily affecting cartilage maintenance and bone growth. One form of this condition, SED tarda (SED-T), exhibits a diverse genetic inheritance pattern, manifesting in three different forms. The autosomal dominant form is linked to variants in the *COL2A1* gene, while the autosomal recessive form is associated with abnormalities in the *CCN6* gene. Additionally, there is an X-linked-form of SED-T related to variants in the *TRAPPC2* gene. Beyond SED-T, there are other types of SEDs, such as SED type C

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Semantic lossless encoded image representation for malware classification

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Combining artificial intelligence with static analysis is an effective method for classifying malicious code. Due to the development of anti-analysis techniques, malicious code commonly employs obfuscation methods like packing, which result in garbled assembly code and the loss of original semantics. Consequently, existing pre-trained code language models are rendered ineffective in such scenarios. Current research addresses this issue by converting malicious bytecode into grayscale images and extracting visual features for classification. However, this process truncates the original sequence, compromising its coherence and structure. Furthermore, the image dimensions undergo compression and cropping based on the model's input requirements, leading to the loss of intricate details. Our solution is a lossless encoding method for the visual structure of code, enabling unrestricted processing of malicious code images of any size. We convert bytecode files into semantically lossless images with proportional width. Then, we use image interleaving encoding to address semantic truncation issues caused by traditional image preprocessing methods. This method also prevents the loss of original code information due to image cropping or compression. For feature extraction, our goal is to combine the lossless encoding results with both local receptive field features and global contextual features. For local features, we achieve uniform embedding of variably sized input samples into equally sized feature maps using a multi-scale feature extraction module. For global contextual features, we reframe the feature maps along the row dimension, treating them as long-text sequences embedded in a matrix. We segment the feature maps into multiple row patch blocks and modify the Transformer's input components to cache and merge the hidden states of each block. Comparative experiments on various malware datasets demonstrate the effectiveness of our method, consistently achieving outstanding performance across classification metrics.

The increasing risk of malicious code attacks have become a persistent global threat known as Advanced Persistent Threats (APTs)[1] for internet users worldwide. As the quantity of malicious code continues to grow, the families and variations are also evolving. Due to its complex and versatile functionality, malware can be classified into various malicious families such as adware, trojans, backdoors, ransomware, spyware, and worms based on its expected platform, type, authorship, and other distinguishing features[2]. Additionally, within malicious code families, subseries and variants can be further divided based on various factors, such as the malicious code library and development group[3].

In scenarios where Windows systems are targeted, attackers often inject malicious code into Windows executable files (PE files)[4]. To evade antivirus detection, malware developers employ various code obfuscation techniques, such as dead code insertion, code packing, and instruction reordering, to hinder security analysts from conducting normal reverse analysis[5]. As code obfuscation techniques evolve, accurately identifying and classifying malicious code with existing methods becomes exceedingly difficult. Therefore, developing more efficient and robust techniques for analyzing the homology of malicious code families and accurately analyzing malware files is crucial for defending against similar malware from the same family.

Excellent code classification models extract hard-to-detect information like that from code obfuscation. Thus, sophisticated feature engineering is needed. Malware classification can be done via static analysis, dynamic analysis, or combined AI technologies based on the extraction process[6]. Dynamic analysis requires executing

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RESEARCH ARTICLE

An Enhanced EWMA Model for Statistical Insights in Process Monitoring with Application in Brake Pad Failure and Carbon Fiber Strength

Muhammad Waqas[1,7] · Song Hua Xu[2,3] · Syed Masroor Anwar[4] · Zahid Rasheed[5] · Gilbert Masengo[6]

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Abstract

Conventional control charts often assume normality, which may not hold for many engineering processes. In cases where processes follow an Inverse Maxwell (IM) distribution, as seen in various industrial applications, it becomes crucial to employ suitable monitoring methods. To address this gap, this study introduces the hybrid exponentially weighted moving average ($HEWMA_{IM}$) chart for the IM distribution. Performance evaluation includes metrics like average run length, median run length, and standard deviation run length. Comparative analysis with existing IM distribution-based charts such as the Shewhart V chart (V_{IM}), exponentially weighted moving average ($EWMA_{IM}$), and extended EWMA ($EEWMA_{IM}$) charts reveal the $HEWMA_{IM}$ chart's superior efficiency. Real-world applications in brake pad production and carbon fiber strength testing validate its practicality and engineering applications. In conclusion, $HEWMA_{IM}$ is a novel tool tailored to monitor IM processes efficiently, offering enhanced process monitoring for diverse industries.

Extended author information available on the last page of the article