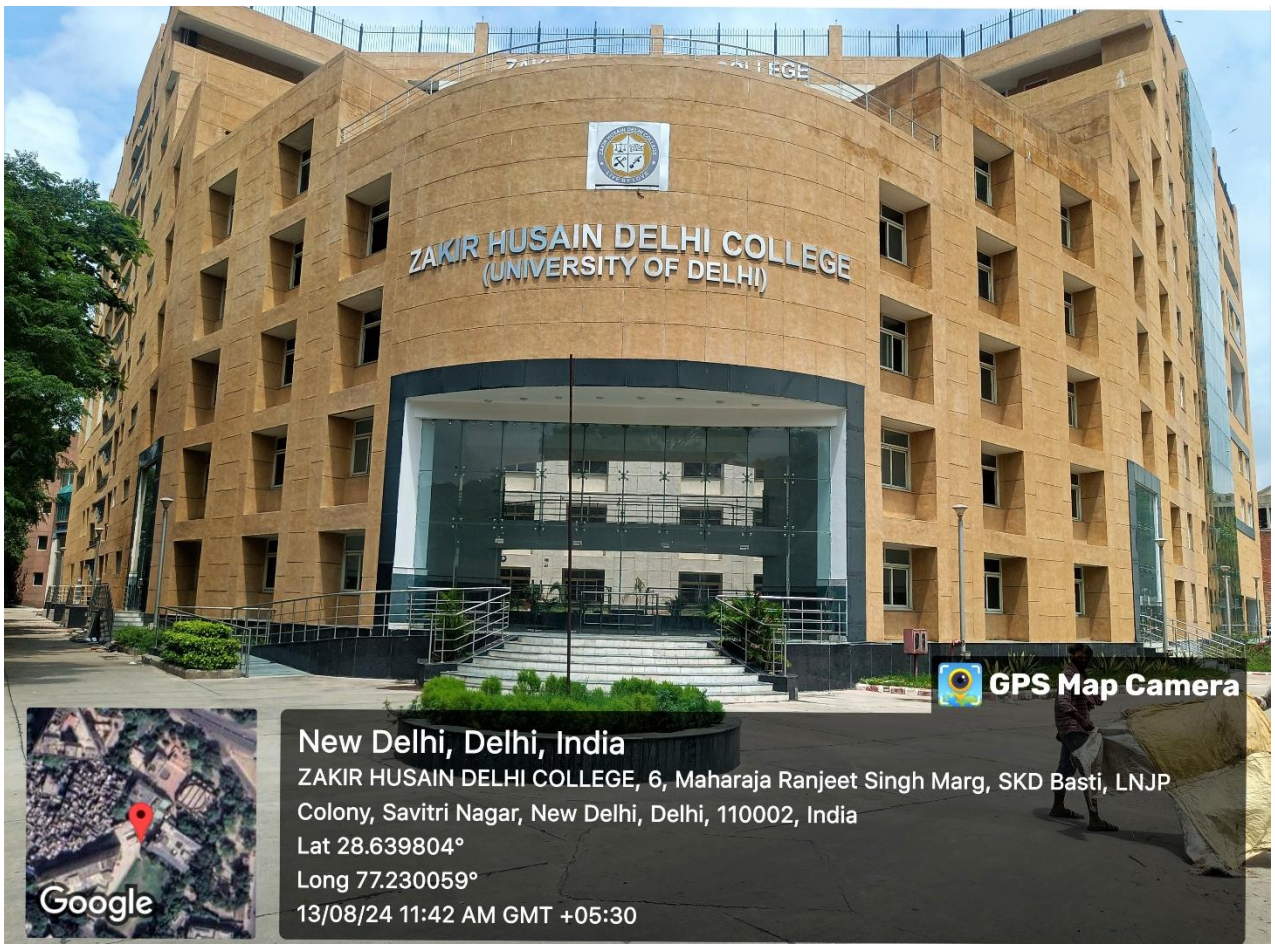
ZAKIR HUSAIN DELHI COLLEGE
UNIVERSITY OF DELHI



SUPPORTING DOCUMENT: 3.5.1

Number of functional MoUs/linkages with institutions/ industries in India and abroad for internship, on-the-job training, project work, student / faculty exchange and collaborative research during 2020-21

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THE KOOTNEETI

Memorandum of Understanding (MoU)

Memorandum of Understanding (MoU) for Academic Collaboration between 'Kootneeti Mediaworks Private Limited', Noida and Zakir Husain Delhi College, University of Delhi

Preamble

This Memorandum of Understanding (this "MOU") made on day 23 of December, 2020 between Zakir Husain Delhi College, University of Delhi (hereinafter referred to as "Zakir Husain Delhi College") and The Kootneeti Mediaworks Private Limited, publisher, (hereinafter referred to as "Kootneeti"). The "Zakir Husain Delhi College" and "Kootneeti", collectively referred to as the "Parties",

RECOGNIZING their mutual interest in the study of Diplomacy, International Relations, Geopolitics, Political Economy and Democratization process as domains of research and Publication.

RECOGNIZING the global nature of today's knowledge expansion through electronic publishing and the need to address them through mutual cooperation and support.

HEREBY agree to encourage academic and educational collaboration as per following guidelines:

1. To establish digital communication on a frequent basis between both parties. To ensure fulfilling the proposed points of collaboration:

- Editorial: We invite senior professors from the college and departments to present their views on global affairs.
- Interviews: We will be pleased to receive your expert views on the topic of higher importance over Emails and other innovative mediums.
- Virtual Roundtable Programs: In this digital world we are more than excited to initiate quarterly faculty-level and monthly youth dialogues between the experts and young scholars from the department and our young fellows.
- Internships: We also invite students from the college to participate in our internship program and reach out to the world of possibilities. Our interns experience the exposure in the field of International Relations while interacting with the Diplomats, Academia, Journalists and likeminded individuals across the globe.
- Joint Research: We also invite the college administration and faculties to take part in high quality researches. This also includes applying for various grants

together from the Universities and Governments in India and abroad, and International Bodies & Corporations.

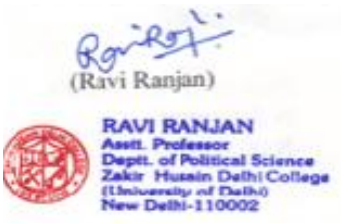
2. Both parties can exchange their sessions, conferences, webinars and workshops on topics of mutual interest.

3. Both Parties can jointly organise sessions, conferences, webinars and workshops on topics mutually acceptable and by following rules, regulations and guidelines issued by Govt. of India, UGC, and Delhi University time to time.

4. This MoU shall have an initial duration of two years from the date of signature, unless either party gives a one-month notice of termination. This MoU may be extended further, in two-year increments by mutual consent. Despite the statements and obligations expressed herein, this MoU is a nonbinding expression of the current intentions of the Parties, and neither Party will incur nor be bound to any legal obligations or expense here under to the other Party until and unless definitive agreements have been negotiated, approved by both parties legally.

This MoU is signed with approval of the competent authority from both sides.

For Zakir Hussain Delhi College



Signature

Dr. Ravi Ranjan
Nodal Officer,
Zakir Hussain Delhi College,
University of Delhi

Date: 24 Dec 2020

For Kootneeti Mediaworks Private Limited

Amrita Dhillon

Signature

Ms Amrita Dhillon
Founding Editor
The Kootneeti
Noida, UP

Date: 24 Dec 2020

Academic Collaboration Report

Zakir Husain Delhi College, University of Delhi over time had expanded the idea of learning beyond the classrooms, and it is the expansive idea which resulted into a collaboration with one of the pioneering media houses on international relations and foreign policy. The Kootneeti Media Publication and Zakir Husain Delhi College announced a collaboration of an academic nature amidst the pandemic in 2020 to assist students into exposing to work culture despite being locked up in their homes. The collaboration was done keeping in mind to have a knowledge partner having in expertise on a domain which closely knits with our daily lives. Therefore, the collaboration was expanded to all departments within the college and not limit it to the humanities departments.

The college under this pronounced collaboration is obliged to organize talks and seminars whereby they The Kootneeti will be entitled to serve as a media and knowledge partner. The idea behind this is to expose students to the vast nature of foreign policy and modern diplomacy. Zakir Husain Delhi College is currently planning future activities that would allow the collaboration to bloom further and even push more students for internships with The Kootneeti.

The college is proud to announce that many students have completed their successful tenure as interns with The Kootneeti and have earned their highest commendation. Arijita Sinha Roy, from the Batch of 2017 who had initially started as an intern with The Kootneeti, currently holds the position of Associate Editor in the company. The college and its fraternity are keen on carrying out such collaborations in the future as well.

Ravi Ranjan,
Associate Professor, Dept of Political Science
Nodal Officer for Collaboration

THE KOOTNEETI
INTERNATIONAL RELATIONS • DIPLOMACY
(An Imprint of Kootneeti Mediaworks Private Limited)

Date: 16 March 2021

Internship Certificate

To Whom it may concern

This letter is to certify that **Charu Damor** has successfully completed her internship program with The Kootneeti. Her internship tenure was from **19 January 2021 to 05 March 2021**.

She has worked as a **Journalism Intern (South Asian Affairs)** which was aimed to highlight challenges and development in the region, including those related to Sri Lanka and Indin Foreign Policy in general. Charu was actively and diligently involved in the projects and the tasks assigned to her.

During the span, we found her of good conduct, punctual and hardworking person. Her learning powers are good and she picks up swiftly. Her feedback and evaluation proved that she learned keenly. Moreover, her interpersonal and communication skills are brilliant.

We wish her a bright future

Sincerely,

Amrita Dhillon
Founding Editor & Director

For and on behalf of
Kootneeti Mediaworks Private Limited

Gmail

Fwd: Research Proposals at LedBy.org

1 message

Simin Akhter <siminakhter@gmail.com> Sat, 10 Aug, 2024 at 11:23 am
To: Dr. Ankur Maheshwari <ankmaheshwari@gmail.com>

Please find the details of the projects I mentored for Ledby below.

---------- Forwarded message ---------
From: **Ruha Shadab** <ruha@ledby.org>
Date: Mon, 20 Jul, 2020, 7:00 pm
Subject: Re: Research Proposals at LedBy.org
To: Simin Akhter <siminakhter@gmail.com>

Thank you, Simin.

Here you go. Please let us know by when we can expect the comments.

Very excited to have your help. Ghazala was full of praise.

Looking forward.

Best,

Ruha Shadab | Founder & CEO

LedBy.org

WhatsApp at +18579996451

From: Simin Akhter <siminakhter@gmail.com>
Date: Monday, July 20, 2020 at 2:59 AM
To: Ruha Shadab <ruha@ledby.org>
Subject: Re: Research Proposals at LedBy.org

Dear Ruha, thanks for the mail. Please send them in.

Best

On Sun, 19 Jul 2020, 22:01 Ruha Shadab, <ruha@ledby.org> wrote:

> Dear Simin,

Thank you for expressing interest in The Led By Foundation. We are a Harvard University funded, US-incorporated not-for-profit. LedBy through its flagship program: Led By Her Fellowship, is the first leadership incubator for Muslim women in India. The primary goal of the foundation is to create a community of high-achieving professional women from a historically disadvantaged community that will support each other and inspire young Muslim women in India to aim for the stars.

Six LedBy fellows are performing research along with their fellowship on the following topics. The deliverable is 2,500 worded manuscript (by August/September)

Would you be interested in guiding them through this? Making sure their research is robust, methodical, and eventually, publishable in journals or newspapers? They all have submitted a one-page research proposal.

1. Ways that can help institutions like the UN to support local conflict resolution mechanisms and letting them own their peacebuilding process instead of solely launching competing mechanisms
2. Islamophobia and Indian Muslim Women/Womyn/Womxn
3. Rise of Indian Muslim women leadership in academic spaces and challenges that follow
4. The plight of Afghan Refugees in India during COVID- 19 and the State's Response
5. Mapping of Water Usage and Preparation for Water Shortage in Aligarh Metro: a study of two residential areas in the ancient University Town of Aligarh
6. Marriage over Higher Education: a choice or surrender, Muslim girls of Old Delhi

These are the tentative timelines:

- **July – September 2020: Research support**
    - July 2020: entails you sending comments on the six research proposal (we might have 8 proposals by the end of the month; and then we will freeze proposal applications). They are 1-3 pages in length.
    - August 2020: Commenting on the drafts (August)
    - September 2020: Commenting on the final submissions (September). These will be ~2,500 words in length.

If this sounds good to you, I could send you the first tranche research proposals to comment (read: shred) upon.

Best,

Ruha Shadab | Founder & CEO

LedBy.org

WhatsApp at +18579996451

---------- Forwarded message ---------
From: **Ruha Shadab** <ruha@ledby.org>
Date: Sun, 19 Jul, 2020, 10:01 pm
Subject: Research Proposals at LedBy.org
To: siminakhter@gmail.com <siminakhter@gmail.com>

Dear Simin,

Thank you for expressing interest in The Led By Foundation. We are a Harvard University funded, US-incorporated not-for-profit. LedBy through its flagship program: Led By Her Fellowship, is the first leadership incubator for Muslim women in India. The primary goal of the foundation is to create a community of high-achieving professional women from a historically disadvantaged community that will support each other and inspire young Muslim women in India to aim for the stars.

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4. The plight of Afghan Refugees in India during COVID- 19 and the State's Response
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Best,

Ruha Shadab | Founder & CEO
LedBy.org
WhatsApp at +18579996451

अनुसंधान अध्ययन बोर्ड (गणितीय विज्ञान)
BOARD OF RESEARCH STUDIES (MATHEMATICAL SCIENCES)
दिल्ली विश्वविद्यालय, दिल्ली-110007
University of Delhi, Delhi-110007
Email: dean_mathsci@du.ac.in Ph.27666041

Prof. Prakash C. Jha
Chairman

Ref. No. BRS(MS)/248/2018/445
Dated: November 15, 2018

MEMORANDUM

Mr. Atul Pandey, a Research Scholar, Department of Mathematics, is hereby informed that Dr. Dhiraj Kumar Singh, Zakir Husain College & Dr. Indivar Gupta, (DRDO) have been appointed as his Supervisors in place of Late Dr. Manish Kant Dubey.

He is required to contact his new Supervisors immediately in connection with his research work.

CHAIRMAN

Mr. Atul Pandey
A-161, New Ashok Nagar
New Delhi - 110096

Copy forwarded for information and necessary action to:

1. The Head, Department of Mathematics, University of Delhi, Delhi-110007.
2. Dr. Dhiraj Kumar Singh (Supervisor) Zakir Husain Delhi College Jawaharlal Nehru Marg, SKD Basti, Press Enclave, Ajmeri Gate, New Delhi, i 110002
3. Dr. Indivar Gupta (Supervisor) DRDO Complex, SAG Metcalfe House, Delhi – 110054.
4. The Dean (Examination), University of Delhi, Delhi-110007.

SECTION OFFICER

Designing and analysis of public key cryptographic protocols using certain algebraic structures

THESIS SUBMITTED TO THE UNIVERSITY OF DELHI
FOR THE AWARD OF THE DEGREE OF

Doctor of Philosophy

in

Mathematics

By

Atul Pandey

Department of Mathematics
University of Delhi
Delhi-110007, India

April, 2022

CERTIFICATE OF DECLARATION

This is to certify that this Ph.D. thesis entitled "**Designing and analysis of public key cryptographic protocols using certain algeraic structures**" submitted to the University of Delhi, Delhi by **Atul Pandey** for the award of the degree of *Doctor of Philosophy in Mathematics*, is a record of his own research work.

The research work embodied in it is original and has not been submitted earlier in part or full or in any other form to any university or institute, here or elsewhere, for the award of any degree or diploma.

Atul Pandey
(Research Scholar)

Dr. Indivar Gupta
(Supervisor)
Scientist 'F', SAG
DRDO, Delhi

Dr. Dhiraj Kumar Singh
(Supervisor)
Associate Professor
Zakir Husain Delhi College, Delhi

Prof. Ruchi Das
Head of the Department
Department of Mathematics
University of Delhi

अध्यक्ष/Head
गणित विभाग
Department of Mathematics
दिल्ली विश्वविद्यालय, दिल्ली-110007
University of Delhi, Delhi-110007

School of Open Learning
(Campus of Open Learning)
University of Delhi

No. SOL / PU/20/198 **Date** 24/2/202

The Principal,
Zakir Hussain College (M),
Ajmeri Gate,
New Delhi-110002

Sub: **Conduct of Academic Counselling Sessions of B.A. (Programme)/B.Com Semester-II on Saturdays of March, 2020 (07, 14, 21 & 28)**

Sir,

I take this opportunity to express my gratitude to you for kind support and co-operation in conducting Academic Counselling Sessions of SOL Under-graduate Courses for the Academic Session 2019-2020 at your esteemed Faculty/College.

It is well aware that the SOL had implemented CBCS (LOCF) Semester System in all undergraduate courses from the Academic Session 2019-2020 and onwards. Accordingly, the Academic Counselling Sessions for Semester-II for one of the courses are being conducted at your Study Centre.

As the SOL started the Academic Counselling Sessions of Semester-II in the first week of February, 2020 hence SOL will be required to conduct some more Academic Counselling Sessions of Semester-II at your Study Centre by the end of March-2020.

In the light of the above and bearing the best interest of the students in mind, you are requested kindly to make necessary arrangements for conducting Academic Counselling Sessions for Semester-II on 07th, 14th, 21st, & 28th March-2020 (Saturdays) also at your Study Centre, so that the SOL students may be able to get their study related doubts dispelled during these extended Academic Counselling Sessions.

Thanking you,

Yours faithfully,

(Dr. U. S. Pandey)
Dy. Director/OSD

S.O. Admn
28.2.2020

Principal's Office,
Receipt No. 689
Date 28-02-2020
Zakir Hussain Delhi College

5, Cavalry Lane, University of Delhi, Delhi-110007
Tel. : 27667600, 27667166, 27667645, Fax : 27667242

SCHOOL OF OPEN LEARNING
UNIVERSITY OF DELHI
5, CAVALRY LINES
DELHI-110007

Ph.No. 27008428, 27667600
27667645, 27667581

Ref. No.PCP/2022/ 218

Principal's Office,
Receipt No. 1127
Date 08-04-2022

Dated 30/3/2022

The Principal
Zakir Hussain College
J.L.Nehru Marg
Delhi- 110002

Sub: **Proposal for Establishment of Learner Support Centre for conducting Academic Counselling Sessions (PCP classes) for SOL Students.**

Sir/Madam,

I may like to submit that School of Open Learning, University of Delhi, is constituent institution of the University of Delhi which imparts quality higher education in distance mode in five under-graduate and five post-graduate courses for about 5 lakh students. To provide better students support services to SOL students, the Governing Body of School of Open Learning in its meeting held on 04th March, 2022 approved the revised guidelines for establishment of SOL Learner Support Centres and Regional Centres. It will be implemented from the academic session 2022-23 onwards.

Accordingly, SOL would like to establish a Learner Support Centre for the students of the SOL in your esteemed Faculty/College/Department. For this purpose some academic, administrative and logistic support would be required from the Faculty/College/Department for conducting Academic Counselling Sessions (PCP classes) smoothly during Saturdays, Sundays & Holidays, and conducting examinations, **if required,** as per the guidelines issued by the University/SOL from time to time. The comprehensive requirements as well as financial implications are given in the enclosed Proposal (Annexure 1).

The admission process for fresh students is likely to commence from April-May 2022 for undergraduate courses for the Session 2022-23 and consequent upon the Academic Counselling Sessions will probably be conducted for the students at Learner Support Centres in the month of April/May 2022 onwards.

I will be grateful to you, if you kindly give your consent to establish a Learner Support Centre in your Faculty/College/Department premises to facilitate Academic Counselling Sessions for the SOL Students and also conduct of examinations, **if required,** as per the guidelines issued by the University of Delhi/SOL from time to time.

The Proposal for the Establishment of SOL Learner Support Centre and guidelines are enclosed alongwith specimen of undertaking to be submitted by the Academic Coordinator on the stamp paper of Rs.100/- for your kind information and necessary compliance.

Thanking you,

Yours faithfully,

Principal (Officiating)

Encls: **As above.**

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सत्यमेव जयते

INDIA NON JUDICIAL

Government of National Capital Territory of Delhi

e-Stamp

Certificate No.	:	IN-DL56427114392513V
Certificate Issued Date	:	02-Feb-2023 03:06 PM
Account Reference	:	IMPACC (IV)/ dl754103/ DELHI/ DL-DLH
Unique Doc. Reference	:	SUBIN-DLDL75410385985640930630V
Purchased by	:	DR NARENDER SINGH
Description of Document	:	Article 4 Affidavit
Property Description	:	Not Applicable
Consideration Price (Rs.)	:	0 (Zero)
First Party	:	DR NARENDER SINGH
Second Party	:	Not Applicable
Stamp Duty Paid By	:	DR NARENDER SINGH
Stamp Duty Amount(Rs.)	:	10 (Ten only)

Please write or type below this line

MEMORANDUM OF UNDERSTANDING
AMONGST
UNIVERSITY OF DELHI, Delhi - 110007
AND
SCHOOL OF OPEN LEARNING, (Campus of Open Learning)
5 Cavalry Lines, University of Delhi, Delhi – 110007
AND
Bhaorao Deoras Sewa Nyas, C – 91, Nirala Nagar, Lucknow – 226020 (U.P)
AND
Zakir Husain Delhi College, Jawahar Lal Nehru Marg, New Delhi-110002.

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Hereinafter collectively referred to as the "Parties" or individually as the "Party"

AND WHEREAS, all parties have agreed for collaboration to work together in the area of Skill Development, Employment and Entrepreneurship Development for the benefit of students of the University of Delhi & its colleges on the following terms and conditions:

1. UNIVERSITY OF DELHI

1.1 The party of the first part is offering various undergraduate and postgraduate degree programmes in its colleges and departments.

2. SCHOOL OF OPEN LEARNING

2.1 The party of the second part offers several courses/ programmes through open and distance learning mode to lakhs of students making education accessible.

3. BHAORAO DEORAS SEWA NYAS

3.1 The party of the third part BDSN through its project SAMARTH BHARAT is engaged in expanding skill development efforts in India by creating an end-to-end, outcome-focused implementation framework, which aligns the demands of the employers for a well-trained, skilled workforce with the aspirations of Indian citizens for sustainable livelihoods.

3.2 SAMARTH BHARAT also endeavours to nurture the entrepreneurs virtually and physically from the ideation till establishing of business Enterprise by providing single window support to the First Generation entrepreneurs or Educated Youth by a step-by-step roadmap for establishing a business enterprise or becoming an industry ready person.

3.3 SAMARTH BHARAT works for enhancing youth behavioural & professional competencies to make them industry ready through various interventions like regular live workshops, seminars, industrial documentaries, skilling, professional & experts episodes on the portal.

3.4 SAMARTH BHARAT provides end-to-end implementation framework for skill development, which provides opportunities for life-long learning and for quality long/short-term skill training that meets the aspirations of trainees as well as outcome focused training that aligns to employer/industry demand and workforce productivity with trainees' for sustainable livelihoods.

3.5 SAMARTH BHARAT focuses to build capacity for skill development in organized and un-organized sectors and provide pathways for re-skilling/up-skilling in pre-identified sectors, to enable them to

f) Create a Start-up support ecosystem in colleges with guidance for Idea and Start-up Launch, Incubation Centre Connect, Pitch development, Investor Tie-ups, etc.

g) Launch peer to peer mentorship program through various mediations like Entrepreneur Talks, Young Achievers Success Stories, Industry & Alumni Connect, etc.

6.3 As and when required, SAMARTH BHARAT shall provide its extensive network to support above mentioned initiatives like connecting with other educational, training institutions, business and industrial bodies, content development, experts network and services.

7. ALL PARTIES

7.1 Draw the attention of the top management in case of any interface or operational problems.

7.2 Will complete the project activities within the agreed time frames of the projects/programs that are initiated and developed.

7.3 Will work towards obtaining necessary ethical, legal, financial, administrative, and other required approvals/ permissions/ acceptance/ sanctions etc., required for joint activities at respective institution as well as from regulatory authority.

7.4 Shall ensure that all activities are conducted while meeting the highest standards of safety and regulations as per prevailing.

7.5 Shall ensure that all the data/information provided by any of the Parties should be used only for the purpose explicitly stated in the specific projects or which ethical/legal clearances are granted by the UNIVERSITY OF DELHI.

7.6 All the knowledge that is generated as a result of joint projects/activities shall be shared by all the parties.

7.7 All attempts will be made to ensure that developments and projects are accomplished to a very high degree of quality, with efficiency of time. All parties shall especially ensure that each party shall complete its tasks correctly in time where work of other party is dependent upon timely and correct completion of its work.

7.8 Not use/ sell/ license/ rent technologies/ resources/ material/ solutions of either parties to/for any third party without prior written mutual consent of the other party.

7.9 Undertake Projects in various areas of mutual interest on mutually agreed terms reduced into writing and signed by all the parties.

11. TERMINATION

11.1 This Memorandum of Understanding can be terminated at any time by any part with or without assigning any reason, by giving six month's written notice to all the other parties.

11.2 Upon termination of this MoU, each party shall return to the other such material, documents etc. belonging to the other parties lying in its possession.

12. SEVERABILITY

12.1 If any party of this MoU is found by a court of competent jurisdiction or other Competent Authority invalid, unlawful, or unenforceable, then such part will be severed from the remainder of this MoU which will continue to be valid and enforceable to the fullest extent permitted by any law.

13. FORCE MAJEURE

13.1 Neither party shall be liable to the other party for any delay or failure on their part in performing any of their obligation under this MoU, resulting from any cause beyond their control, but not limited to strike/ lock-outs, fires, floods, earthquake, explosions, war, enemy action, or political changes, natural disaster or military hostilities and strike of employees, the act or omission of any third party for whom the parties are not responsible.

13.2 Each of the parties agrees to give notice immediately to the other party upon becoming aware of an event of force majeure and such notice should contain details of the circumstances giving rise to it.

13.3 If a default due to force majeure continues for more than 6 weeks then the party not in default shall be entitled to terminate this agreement.

13.4 Neither party shall have any liability to the other in respect of the termination of this agreement as a result of force majeure.

14. LIMITATION OF LIABLITY:

14.1 In no event any of the parties be liable to the other party for any incidental, consequential, special and exemplary or direct or indirect damages, or for any lost profits, lost revenues, or loss business arising out of the subject matter of this MoU, regardless of the cause of action, even if the party has been advised of the likelihood of damages if the same is without intention and beyond reasonable control

20. NON-WAIVER

20.1 The failure or neglect by any of the Parties to enforce any of terms of this MOU shall not be construed as waiver of its rights preventing subsequent enforcement of such provisions or recovery of damages for breach thereof.

21. SIGNED IN DUPLICATE

21.1 This MoU is executed in quadruple with each copy being an official version of the agreement and having equal legal validity and supersedes all prior oral and written agreements, understandings, representations, conditions and all other communications relating thereto. Both copies together will constitute binding contract.

IN WITNESS WHEREOF, THE DULY AUTHORIZED REPRESENTATIVES OF THE PARTIES SIGNED THIS MEMORANDUM OF UNDERSTANDING AT THE PLACE AND ON THE DAY WRITTEN BELOW

(Dr. Vikas Gupta)
Registrar
University of Delhi

डॉ. विकास गुप्ता / Dr. VIKAS GUPTA
कुलसचिव/Registrar
दिल्ली विश्वविद्यालय/University of Delhi
दिल्ली–110 007/Delhi-110007

(Prof. Payal Mago)
Chairperson
School of Open Learning

(Shri Rahul Singh)
General Secretary
SAMARTH BHARAT – BDSN

(Prof. Narendra Singh)
Principal
Zakir Husain Delhi College

THE SEAL OF NOTARY PUBLIC
M. L. GARG
App. By
Govt. of NCT
of Delhi India
Regd. No. 35/09
DELHI

ATTESTED
Notary Public, Delhi
- 2 FEB 2023

15. GOVERNING LAW & JURISDICTION

15.1 All disputes regarding this MoU shall be under the jurisdiction of the Civil Courts of Delhi only.

15.2 This MoU shall be governed and interpreted in accordance with the established Law. Court of New Delhi shall have exclusively jurisdiction to try, entertain, and decide the matters, which are not covered under the Civil Courts.

16. COMMUNICATION

16.1 Each party shall nominate its Nodal Person who shall be the single point of authority for the purpose of implementation of this MoU.

16.2 Each Party is free to change or reappoint such contact point on its behalf with a notice to the other Party.

16.3 Each party may change nodal contacts/ address by written notice in accordance with this paragraph.

17. NOTICES

17.1 Any Notice, request, demand, approval, consent or other communications provided or permitted hereunder shall be in writing in Hindi/English Language and given by personal delivery or sent by registered post or by fax/email addressed to the above nodal contacts.

17.2 Notices delivered personally will be deemed communicated as of actual receipt. Mailed notices will be deemed communicated as of four (4) days after mailing.

17.3 Post-mailed notices will be deemed communicated as of seven (7) days after mailing.

18. MODIFICATION

18.1 No modification to this MoU, will be effective unless agreed to in writing by all the parties and duly signed by the authorised signatories of the Parties.

19. HEADING

19.1 The headings shall not limit, alter or affect the meaning of the Clauses headed by them and are solely for the purpose of easy reference.

7.10 Ensure the safety of the personnel and material whenever placed at all ends by the all the parties.

8. CONFIDENTIALITY, COPYRIGHT AND INTELLCTUAL PROPERTY RIGHTS

8.1 Existing IP as on date of execution of this MoU shall be exclusively owned by respective parties to which the IP belongs.

8.2 All the parties shall be ensured that all the data/information provided by either party will be used in accordance with the regulations and guidelines on human ethics and privacy of personal data law and also strictly in accordance with the Indian Intellectual Property Laws and Rules.

8.3 The intellectual property (including but not limited to inventions, ideas, innovations know-how/ process/ design/ technique/ copyright/patent etc.,) generated / created / designed / developed in relation to or arising out of or incidental to any projects initiated under this MoU shall be owned jointly by all the parties.

8.4 All the parties agree to hold in confidence all data/information designated by either party as being confidential which is obtained from either party or created during the operation of this MoU and shall not be disclosed to any outsider without written consent of all parties.

8.5 For any intellectual property arising during the operation of this MoU, respective Participating Institutions intend to ensure adequate and effective protection of the same in order to maintain its uniqueness and shall never be shared with any outsider.

9. REVENUE SHARING

9.1 Bhaorao Deoras Seva Nyas through its project SAMARTH BHARAT provides a facilitating platform for skill development, jobs and business start-up to the needy people without charging any fees.

9.2 UNIVERSITY OF DELHI, SOL & Zakir Husain Delhi College shall provide resources required to support their students like training infrastructure, remuneration directly to trainers, staff for management of Career Development Centre, etc.

10. COMMENCEMENT AND DURATION

10.1 This MoU shall be effective from the date of signature by the Heads of all the parties and/or their nominees. This MoU will be valid for 05 Years (Five Years) from the date of its commencement.

Xerox Copy

transit into formal sector employment through a developed network of quality instructors thereby we will establish this ecosystem through high-quality teacher training institutions and leveraging existing public infrastructure and industry facilities.

4. The party of the fourth part is a constituent college of the University of Delhi offering various undergraduate and postgraduate degree programmes.

5. SCOPE OF THE MOU

This MOU is only to facilitate collaboration to work together in the area of Career Counselling, Skill Development, Employment, Entrepreneurship Development, Start-up support and Mentorship Program for the benefit of students of UNIVERSITY OF DELHI, Delhi without any financial implications from either of the parties.

6. ROLE AND RESPONSIBILITIES

6.1 All parties will work together to create a career development framework and implement it through a Career Development Centre based in the premises of the FOURTH PART.

6.2 All parties shall appoint respective Single point of contact (SPOC) that will work together to identify/develop and implement various career development offers including but not limited to

a) Inspiring students to take self-development as a lifelong habit. The same shall be achieved through creation of Career Development Centre, Community, Career Support Helpline, University of Delhi, SOL, Samarth Bharat & Zakir Husain Delhi College Website, Support Groups, etc.

b) Implement career counselling framework to identify competency, interest and prospective career paths including exposure to various career options with guidance to choose the right career path & skilling/educational requirements.

c) Creating college based or external training infrastructure (E-Learning/ Classroom/ Internships) for various trainings like – Employability Skills & Workplaces issues, Finance Management & Investing, Competency Development, Vocational Skills, etc.

d) Organise various job placement opportunities including – Domestic & Global Work Opportunities (Technical Intern Training Program, Etc.), Earn while u learn – part time jobs & Internships, etc.

e) Organise various interventions for Entrepreneurship Development Program including exposure to industrial sector wise business opportunities, training in industry, business start training including guidance on how to organise finance for projects, etc.

THIS MEMORANDUM OF UNDERSTANDING (hereinafter referred to as "MoU") is made and executed on 07th February, 2023 at Delhi.

By and among

UNIVERSITY OF DELHI, Established in 1922 as a unitary, teaching and residential University incorporated under The Delhi University Act, 1922 as amended from time to time comprising of 16 faculties, 86 departments and 91 colleges (herein after referred to as "UNIVERSITY OF DELHI", which expression shall, unless it be repugnant to or inconsistent with subject or context thereof, include and be deemed to include their heirs, executors, successors or administrators and permitted assigns), represented by its Registrar, Dr. Vikas Gupta.

Party of the First PART

AND

The School of Open Learning (Herein after referred to as SOL) a part of the Campus of Open Learning formerly known as the School of Correspondence Courses and Continuing Education, established under the University of Delhi in 1962, is a pioneer Institution in the field of Distance Education in India, represented by its Chairperson, School of Open Learning, Prof. Payal Mago.

Party of the Second PART

AND

Bhaorao Deoras Seva Nyas is a Non-Profit Charitable Trust (under Section 12AA) registered in 1993 having its registered office at C-91, Nirala Nagar, Lucknow, Uttar Pradesh - 226020 (hereinafter referred to as "BDSN", which expression shall, unless it be repugnant to or inconsistent with subject or context thereof, include and be deemed to include their heirs, executors, successors or administrators and permitted assigns) represented by its General Secretary, Shri Rahul Singh.

Party of the Third PART

AND

Zakir Husain Delhi College, is a constituent college of the University of Delhi and located at Jawahar Lal Nehru Marg, New Delhi-110002, India (herein after referred to as "Respective college, Delhi", which expression shall, unless it be repugnant to or inconsistent with subject or context thereof, include and be deemed to include their heirs, executors, successors or administrators and permitted assigns) represented by its Principal, Prof. Narendra Singh.

Party of the Fourth PART

Toggle Navigation   Spoken Tutorial

- Software Training
  - **Software Training**
    - About the Training
    - Progress to Date
    - Software Offered
    - Contacts for Training
    - Change in Training Policy

    Procedures

    - Organising Training
    - Instruction for Downloading Tutorials
    - Create Your Own Disc Image
    - Resource Centers

    Training

    - Training & Payment Dashboard
    - Semester Training Planner Summary (STPS)
    - Student Dashboard
    - new Individual Learning
    - Individual Learning Workshop
    - Verify ILW test certificate

    Online Test

    - Instruction for Invigilator
    - Instruction for Participants
    - Certificate Verification Link
    - Email Verification Link
    - new Job Recommendation
- Creation
  - Creation Process
  - Outline and Script
  - Creation Dashboard
  - Suggest a Topic
  - Suggest an Example
  - Collaborate with Us
- News
  - Testimonials
  -
  - Articles on Spoken Tutorial project
  -
  - Events & Happenings
  -
  - Research / Popular Articles
- Academics
  - MOOCs acceptance
  -
  - Official Letters and Links

List of Training Events :

State

Foss

Host College
Zakir Husain Delhi College
Event Start Date Range
-
Event End Date Range
-
Event Type
Student Training Programme
Filter Reset Filter

- Ongoing Events

- Past Events

March 20, 2023 - March 30, 2023

SDP

Zakir Husain Delhi College organising Student Development Program on LaTeX

Host College : Zakir Husain Delhi College, Delhi
Event Coordinator Name : Dr. Dhiraj Kumar Singh
FOSS : LaTeX

Registration open from **March 15, 2023, till March 19, 2023**

Dec. 21, 2022 - Jan. 3, 2023

SDP

Zakir Husain Delhi College organising Student Development Program on R

Host College : Zakir Husain Delhi College, Delhi
Event Coordinator Name : Dr. DHIRAJ KUMAR SINGH
FOSS : R

Registration open from **Dec. 6, 2022, till Dec. 20, 2022**

Aug. 25, 2022 - Sept. 8, 2022

SDP

Zakir Husain Delhi College organising Student Development Program on Python 3.4.3

Host College : Zakir Husain Delhi College, Delhi
Event Coordinator Name : Chaitra H Gawade
FOSS : Python 3.4.3

Registration open from **Aug. 18, 2022, till Aug. 23, 2022**

June 16, 2022 - June 30, 2022

Zakir Husain Delhi College organising Student Development Program on Chemcollective Virtual

SDP

Labs

Host College : Zakir Husain Delhi College, Delhi
Event Coordinator Name : Chaitra H Gawade
FOSS : ChemCollective Virtual Labs

Registration open from **June 8, 2022, till June 14, 2022**

March 11, 2022 - March 25, 2022

SDP

Zakir Husain Delhi College organising Student Development Program on Python 3.4.3

Host College : Zakir Husain Delhi College, Delhi
Event Coordinator Name : Chaitra H Gawade
FOSS : Python 3.4.3

Registration open from **March 4, 2022, till March 8, 2022**

Feb. 14, 2022 - Feb. 28, 2022

SDP

Zakir Husain Delhi College organising Student Development Program on R

Host College : Zakir Husain Delhi College, Delhi
Event Coordinator Name : Chaitra H Gawade
FOSS : R

Registration open from **Jan. 31, 2022, till Feb. 10, 2022**

Dec. 21, 2022 - Jan. 3, 2022

SDP

Zakir Husain Delhi College organising Student Development Program on R

Host College : Zakir Husain Delhi College, Delhi
Event Coordinator Name : Dr. DHIRAJ KUMAR SINGH
FOSS : R

Registration open from **Dec. 6, 2022, till Dec. 20, 2022**

Jan. 15, 2021 - Jan. 30, 2021

SDP

Zakir Husain Delhi College, University of Delhi Organising SDP on R Programming

Host College : Zakir Husain Delhi College, Delhi
Event Coordinator Name : Dr. Dhiraj Kumar
FOSS : R

Registration open from **Jan. 7, 2021, till Jan. 12, 2021**

Oct. 1, 2020 - Oct. 15, 2020

SDP

Programing in Python

Host College : Zakir Husain Delhi College, Delhi
Event Coordinator Name : Dr. Dhiraj Kumar Singh
FOSS : Python 3.4.3

Registration open from **Sept. 22, 2020, till Sept. 28, 2020**

- FOSSEE Project
- Scilab
- eSim (Oscad)
- Python
- OpenFoam (CFD)

- Aakash Labs
- Co-learn
- Education Mission

- Software Training
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- About Us
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Annual Reports (AY: 2020-21)

Department of Environmental Studies, Zakir Husain Delhi College, University of Delhi

Name of Department- Environmental studies

Course Co-ordinators- Dr. Ratnum Kaul Wattal (15th Jan 2020 to 31st March 2023)

Dr. P R Raagesh (-till date

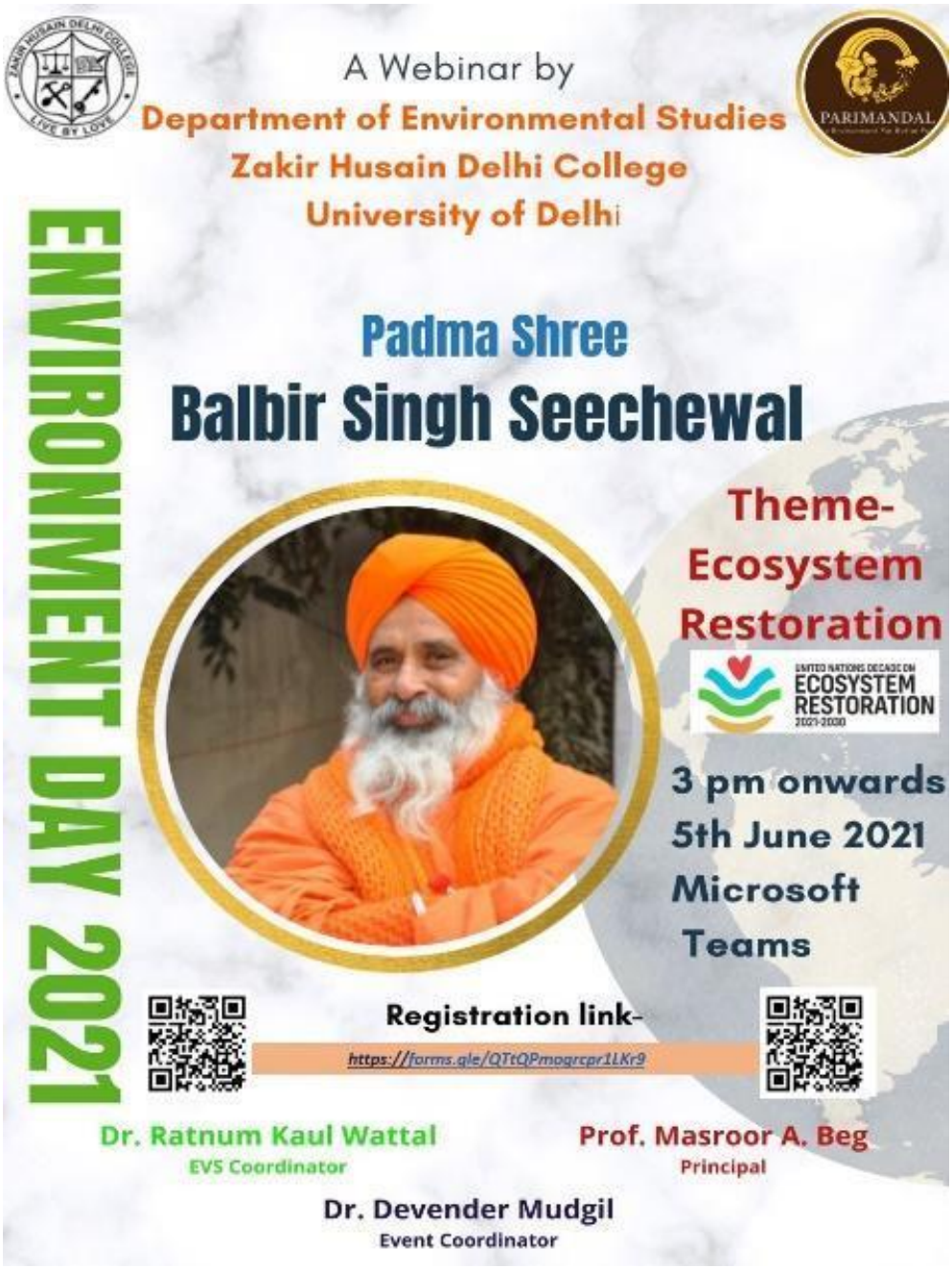
Faculty- Dr. Lakshmi Hooda, Dr. Saurabh Sonwani, Dr.Devender

Department of Environmental studies has constituted a departmental society named "PARIMANDAL" and actively spreading awareness amongst the student community and the common people through social media like Facebook page, Instagram account and Youtube channel.

Year 2021

1) On the Occasion of "***WORLD ENVIRONMENT DAY-2021***" Department of Environmental Studies organized a webinar on WED 2021 theme ecosystem restoration on 5th June 2021 on MS Teams platform. ***Padma Shree Awardee Sant Balbir Singh***

Seechewal, renowned environmentalists was the speaker for the webinar. His event was also



registered at the UNEP website.

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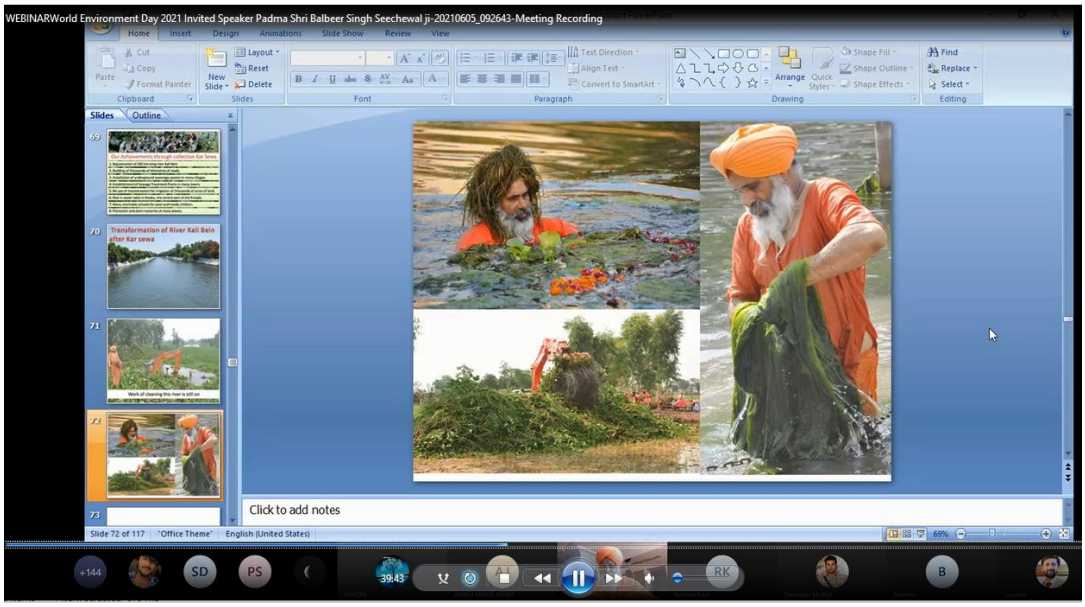

NSS, ZHDC

2020-2021

Orientation Programme – 5th March, 2021

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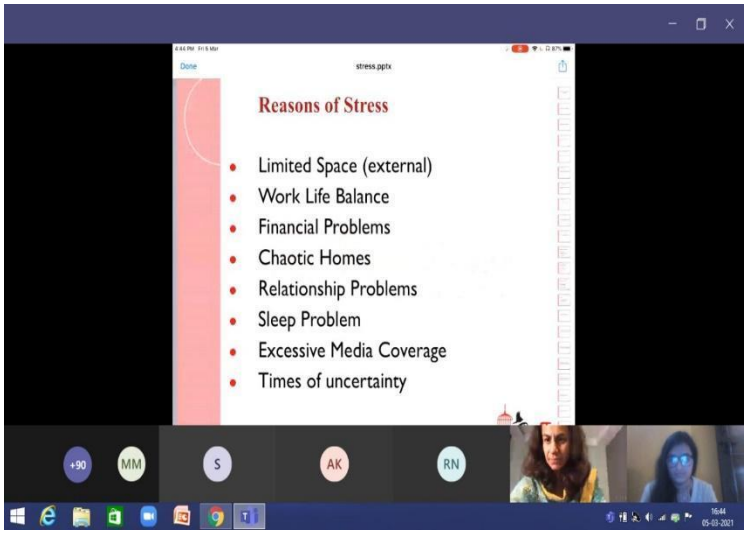

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Yoga Day Celebration – 21st June, 2021

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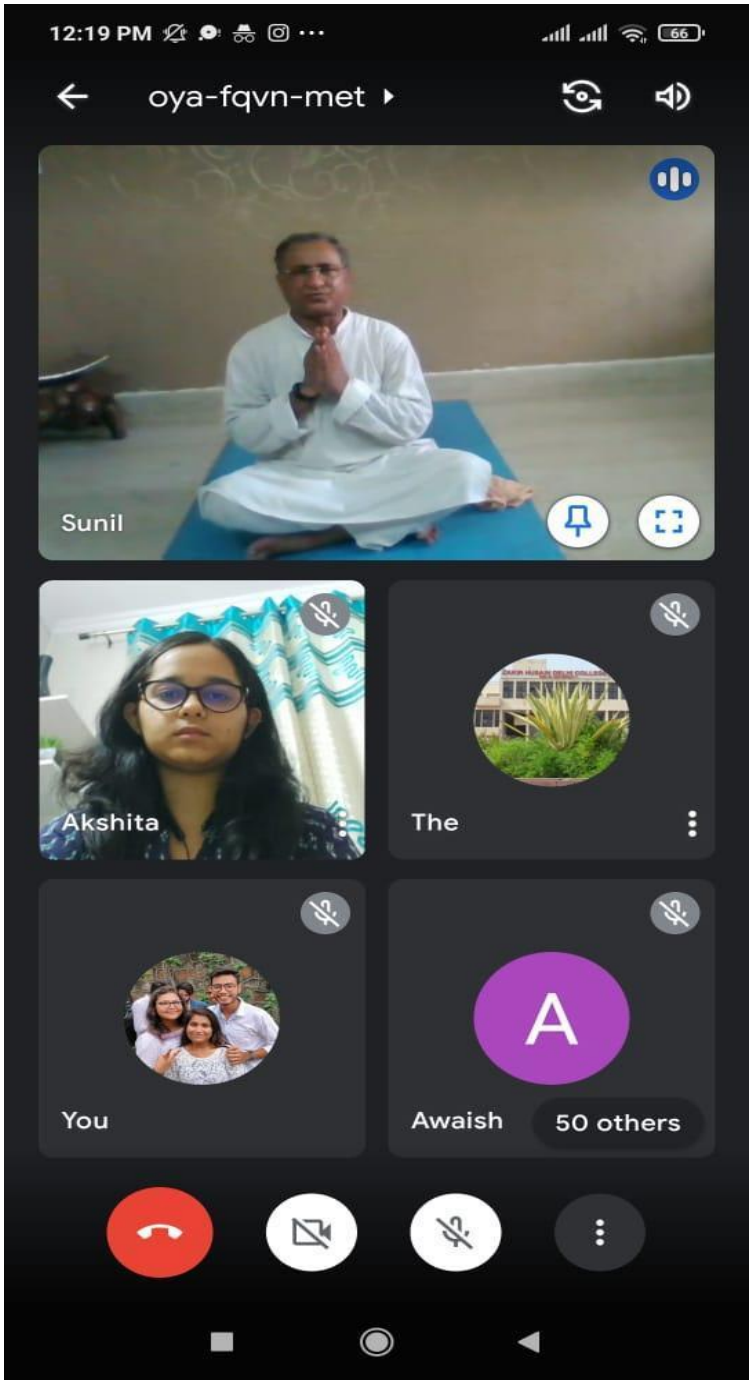

Gandhi Study Circle, ZHDC

Gandhi Jayanti Celebration and 1st Lecture of

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"Distinguished Gandhi Lecture Series" by Prof Akeel Bilgrami, 2nd October 2020

Commemorating Mahatma Gandhi on his 151st birth anniversary celebration, Gandhi Study Circle organized a weeklong celebration with a series of events, both academic and creative. Before 2nd October, a week-long online competition was organized namely Mono act, Digital art, and letter-Writing. In Mono- Act, participants were asked to present a short mono-act on the theme "Be the voice of the institution you think has suffered the most in independent India" meanwhile in letter writing competition theme decided for the participants were "A letter from Gandhi to address Contemporary Distress" which, in other words, was an open-letter writing competition. Adding to the necessity of time, a modern set of technical competition digital Art on the theme of "Undoing 2020" was also organized.

On 2nd October 2020, Gandhi Study Circle organized "Gandhi Jayanti celebration" in collaboration with Gandhi Study Circle, Miranda House in which a relaxing meditative session was organized in which illustrious BK Nikita Ji, let the audience understand the importance of meditation and its habitable practice. In the event, meditation was also practiced for a considerable duration of time. The entire event was highly interactive and enriching along with a meditative session. Another event "Dastan - E-Bapu" in which an enriching "Dastan Goi" a unique form of storytelling by MS Rupali Gupta of Miranda House served the essence and importance of the day.

In the same very event, core members of Gandhi Study Circle, Zakir Husain Delhi college recited poems dedicated to the greatness and the personality of

our respected Bapu.

On 2nd October 2020, in the evening, Gandhi Study Circle inaugurated another great initiative of the “Distinguished Gandhi lecture series” which is still in practice and three different lectures of this series have been organized.

The inaugural lecture of this series was presented by an eminent personality Akeel Bilgrami, professor department of philosophy at Columbia University who is an Indian philosopher of language and mind. Professor Bilgrami endorsed and embraced the evening of Gandhi Jayanti on "Gandhi's Legacy of our Times". The talk was joined by eminent scholars all over the world. The conversation became fruitful and enriching by the sharp interventions by the Scholars and the audience who attended the event. The event was telecasted live on Facebook and the YouTube page of GSC and we had more than 250 participants. The link to the lecture is provided below.

https://youtu.be/qxc7dwIxMDw

3rd Lecture of Distinguished Gandhi Lecture Series, 15th January 2021

Functioning in online mode persuaded our core members to utilize the online platform to its best by organizing an international webinar under the guidance and support from our convener Dr. Sanjeev Kumar. The society organized its 3rd lecture under 'Distinguished Gandhi Lecture Series' on 15th January 2021 on online platform zoom, the event was organized in collaboration with 'Gandhi Research Foundation', the theme of the lecture was 'Gandhi and Swaraj in ideas'. The lecture was delivered by eminent dignitary Lord Bhikhu Parekh, emeritus professor Political Philosophy, University of Westminster and Member of Parliament of United Kingdom, the event was chaired by Professor Geeta Dharampal, Dean, and prof. of Gandhi Research Foundation, Jalgaon.

The event began with an opening video created by our core student member, which introduces the society and the events it has organized in the past year, and through the ongoing pandemic, the event concluded with a question-answer session that was moderated by the student member of Gandhi Study

Circle. The discussion was joined by scholars like prof. Faisal Devji, Dr. Gopal Guru, renowned personalities like Mr. Mark Tully, former BBC Bureau Chief, and students from universities across the globe. The event witnessed the presence of more than 347 participants and was telecasted live on Facebook and the youtube page of Gandhi Study Circle, allowing more participants to join it. The link to the lecture is provided below.

https://youtu.be/6gBDMfewOyE

Film festival on "ENVIRONMENT, WILDLIFE & CLIMATE CHANGE"

1) Department of Environmental Studies in collaboration with ***CMS-Vatavaran*** organized a film festival on "***ENVIRONMENT, WILDLIFE & CLIMATE CHANGE***" on 17th February 2021 on Microsoft Teams platform. Famous documentaries (*Foresting Life* by *Ms. Aarti Shrivastav*; *Koti Banal* by *Mr. Shriniwas Oli* and *The Tiger's Revenge* by *Mr. S Nallamuthu)* focused on environmental issues were screened and their directors answered the live Q&A answer session.

Meeting Link-

https://teams.microsoft.com/l/meetup-join/19%3ameeting_YzhkODMzYWItNDc4OS00ZGIxLWEyYWMtYTk5Y2FkNjQ5ZTQz%40thread.v2/0?context=%7b%22Tid%22%3a%224efd407c-d483-49ca-affa-7aa06c395aaf%22%2c%22Oid%22%3a%22741ad325-1151-42d4-bfa9-a8d53e77e87c%22%7d

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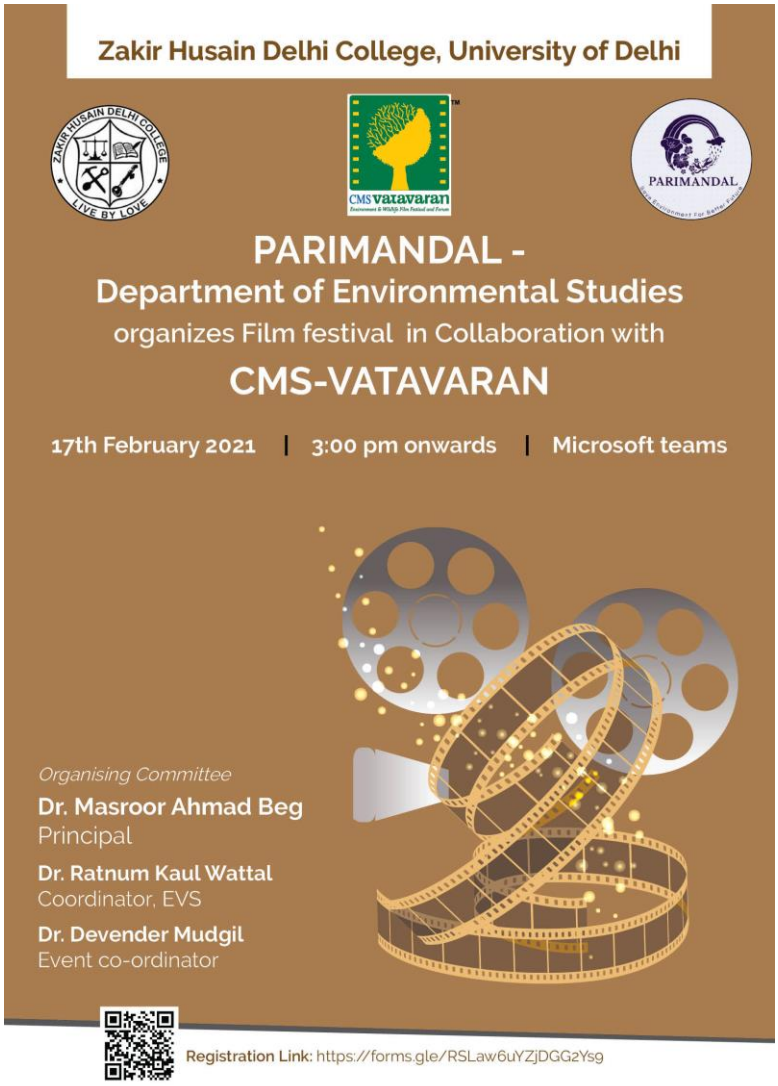

Event Schedule (Minute by minute)

2:45 PM- Team, Department of Environmental studies will join the meet

2:50- 2:58 PM- Videos on CMS-Vatavaran Introduction

2:58 -3:00 PM- *Saraswati Vandana*

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3:00-3:03 PM- Welcome and Brief Intro about Event – Dr. Devender Mudgil

3:03-3:06 PM- Synopsis of film and brief Introduction of director ***Ms. Aarti Shrivastav*** **3:06- 4:15-** Screening of "***Foresting Life"***

4:15- 4:25- Question and answer session

4:25- 4:28 PM- Synopsis of ***The Tiger's Revenge*** and brief Introduction of director S Nallamuthu

4:28- 5:12PM- Screening of ***The Tiger's Revenge***

5:12-5:15 PM- Synopsis of ***Koti Banal*** and Introduction of director ***Mr.Shriniwas Oli***

5:15- 5:27 PM- Screening of ***Koti Banal***

5:27- 5:37 PM- Question and answer session

5:37-5:45 PM- Vote of thanks by ***Dr. Ratnum K. Wattal*** and closing of event

Invitation sent-348
Attendance- 100+ students

ाकिर हुसैन दिल्ली कॉलेज

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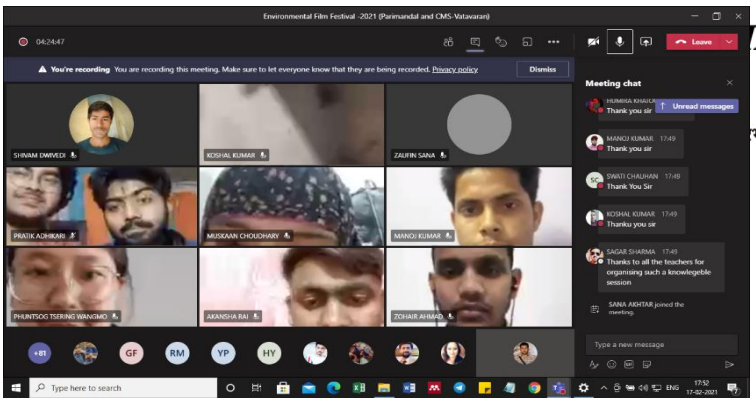

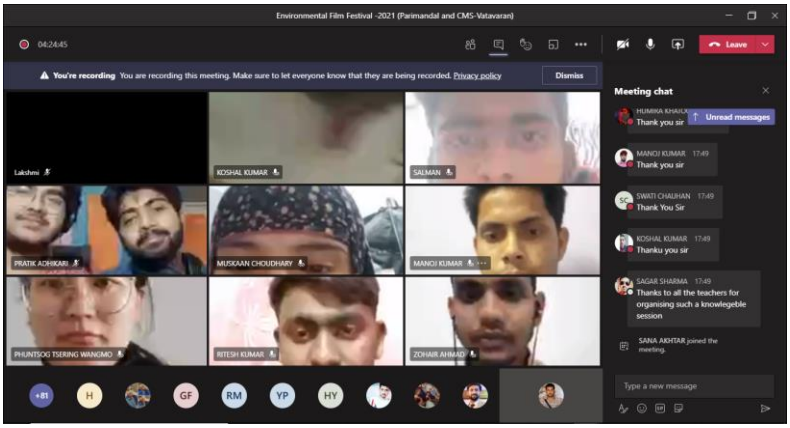

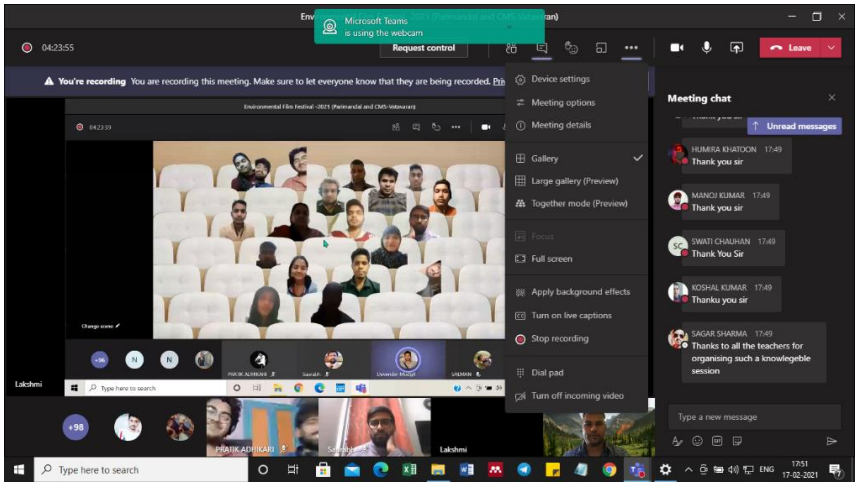

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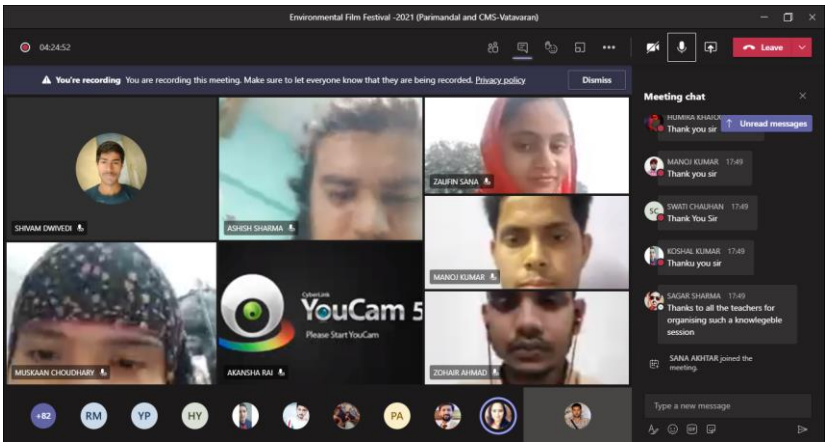

Guru Angad Dev
TEACHING LEARNING CENTRE

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UNIVERSITY OF DELHI

Code: GAD-TLC/20-21/OFDP26/OCM003

Date : 23rd November 2020

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This is to certify that **Dr Sarita Passey**, **Zakir Husain Delhi College** has contributed as a **Member of Organizing Committee** for the conduct of One Week National Faculty Development Program on **"Towards Quality Higher Education through NEP-2020"** between 27th October 2020 – 2nd November 2020 organized by Guru Angad Dev Teaching Learning Centre, S.G.T.B. Khalsa College, University of Delhi under the Pandit Madan Mohan Malaviya National Mission on Teachers and Teaching (PMMMNMTT) of MHRD. This was conducted in flexible online mode.

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Dr. Vimal Rarh
(Project Head & Joint Director)

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Date: 15th June 2021

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This is to certify that **Dr. Sarita Passey**, **Zakir Husain Delhi College, University of Delhi** has contributed as **Organizing Secretary** in One Month Online National Faculty Induction Program organized by Guru Angad Dev Teaching Learning Centre, S.G.T.B. Khalsa College, University of Delhi under the Pandit Madan Mohan Malaviya National Mission on Teachers and Teaching (PMMMNMTT) of Ministry of Education held on **03rd December to 30th December 2020**.

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SRI GURU TEGH BAHADUR KHALSA COLLEGE
UNIVERSITY OF DELHI

Date: 15th June 2021

To whomsoever it may concern

This is to certify that **Dr. Sarita Passey**, **Zakir Husain Delhi College, University of Delhi** has contributed as **Organizing Secretary** in One Week Online National Faculty Development Program on **"Enhancing Quality of Chemistry Education in India"** organized by Guru Angad Dev Teaching Learning Centre, SGTB Khalsa College, University of Delhi under the Pandit Madan Mohan Malaviya National Mission on Teachers and Teaching (PMMMNMTT) of Ministry of Education held on **25th February to 03rd March 2021**.

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REVIEW ARTICLE

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Ethylene mediated physiological response for in vitro development of salinity tolerant tomato

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ABSTRACT

Tomato is an important crop and has immense health benefits and medicinal value. Here, we described how salinity stress affects tomato plant growth and developmental processes and productivity. It causes ionic toxicity, oxidative damage, osmotic stress, and hormonal imbalance. In this review, we emphasized the crucial role of ethylene (ET) towards in vitro development of tomato crop by mediating stress response, particularly high salt. There are evidences that salinity stress modulates the expression of ACS and beta-CAS, which leads to ET and cyanide accumulation. We draw attention to how ET negatively or positively mediates salinity stress response by maintaining endogenous biomolecules, Na^+/K^+ ion balance and redox homeostasis. How ET inhibitors and polyamines as protectants reverse the negative effects of ET/salinity stress-induced cellular damage by cross talk with important physiological processes-photosynthesis and respiratory and salt overly sensitive (SOS). The literature appraised herein will contribute to a better understanding of the development of salinity stress tolerant tomato.

ARTICLE HISTORY
Received 13 April 2020
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KEYWORDS
Ethylene; reactive oxygen species; salicylic acid; salinity stress; tomato

Introduction

The global population is expected to cross 9.6 billion by 2050, leading to exceeded demands on already extracted natural resources. Global climate change in the form of environmental stress is a major constrain to crop productivity. There is an urgent need to improve plant survival in changing environment to sustain plant productivity (Abdallah et al. 2014; UN-DESA 2017; Dahal et al. 2019). The diverse abiotic stresses are known to affect tomato productivity at a large scale. Salinity stress is important not because of its destructive and deleterious nature to reduce crop productivity, but also because of its mechanism of action which is not completely understood. It affects several dicotyledonous crops in which tomato is a nominated model to examine salinity stress response (Khan 2016; Joseph et al. 2018). The tomato fruit is the fruit of one of the significant horticultural crops because of antioxidative and anti-cancer properties, and have considered an excellent source of antioxidants and taurines, and dietary fiber, minerals, vitamins, and lycopene content (Grabowska et al. 2019). Technological management and sustainable methods are the two most important approaches to mitigate the negative effects of high soil/water salinity in agriculture. The technological approach, based on renovation, drainage, and irrigation practices with high-quality water, is costly and devoid of a complete solution. In the case of sustainable agriculture production in the presence of high salts which relies on the development of salinity stress-tolerant crops by crop substitution, adopting wild species, unmanned aerial vehicle-based phenotyping and genetically modifying crops (Epstein et al. 1980; Johansen et al. 2019). Several studies have been put forth to explain salinity tolerance in tomato crops in which plant hormones are the key players (Sahoo et al. 2014; Shah et al. 2018). In the present review, a potential role of plant hormone ethylene homeostasis and its cross talk in somaclone generated tomato plants under high salinity stress to produce salinity stress tolerant tomato will be discussed (Figure 1(A)).

Hyper osmotic stress and hyperion toxicity are the major problems that influence salt-stressed plants (Gorham et al. 2010). Under high salinity stress conditions, roots are not able to uptake water directly from the soil, causing toxic concentrations of sodium and chloride, plant nutritional disorders, and oxidative damage (Rouphael et al. 2018). The accumulated sodium obstructs with potassium and calcium uptake and thereby negatively affecting stomatal movement and photosynthesis. Therefore, the salt stress condition of a crop relies mainly on the potassium-to-sodium ratio than on the total amount of sodium present in the cytosol

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Article

Antioxidant Metabolism of Tomato (*Lycopersicon esculentum* L.) Seedlings under Polyethylene Glycol (PEG) Induced Drought Stress Condition

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Abstract: The study was conducted to investigate the effect of Brassinosteroid (BR) application on the germination, physiological and biochemical parameters in week-old tomato seedlings under different treatments, i.e.,) Distilled water (control); ii) 15% polyethylene glycol (PEG) solution (drought stress (DS); iii) BR concentration @ 0.30µM and iv) 15% PEG supplemented with BR concentration @ 0.30µM. The water deficit condition resulted in a significant reduction in seed germination, growth, and tomato seedlings' biomass development. BR application improved these parameters under both control and DS conditions. In addition to this, BR application alone, as well as under PEG-induced drought, improved the antioxidant activity and osmolyte accumulation. It resulted in the reduction of H_2O_2 generation and lipid peroxidation resulting in overall ionic homeostasis and maintenance of tissue osmotic conditions. In conclusion, PEG induced DS resulted in an adverse effect on seedlings growth and development, which was alleviated under BR application.

Keywords: Abiotic stress; Antioxidant system; drought stress; oxidative stress;*Lycopersiconesculentum.*

1. Introduction

Drought Stress (DS) is one of the common abiotic stresses which restrict the growth and development of various plants. Drought tolerance in plants is a trait which is resulted due to the integration of several biochemical and molecular phenomena [1]. Under water deficit conditions, vital plant processes are affected, and nutrient uptake, photosynthetic mechanism, protein synthesis are drastically down [2]. DS results in reactive oxygen species (ROS) production, which results in oxidative stress, which disturbs the plant ion homeostasis [3]. Thus, maintenance of normal ion homeostasis is of prime importance to cope with the ill effects of DS. Under such conditions, plants counteract by activation of ROS scavenging mechanisms, which include an accumulation of

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Assessment of cytotoxic and genotoxic effects of Yamuna river water pollutants in an urban metropolis, Delhi (India)

Zahid Hameed Siddiqui, Ratnum Kaul Wattal, Hareramadas Batchu and Zahid Khorshid Abbas

ABSTRACT

The present study evaluates the hazardous effects of water pollutants present in the River Yamuna, the lifeline of Delhi. This was done by collecting water samples from seven sites on the River Yamuna, and studying their water quality parameters (WQP). In all cases, tap water was taken as the control, and WQP like pH, salinity, electrical conductivity (EC), etc. were measured. At site 1, water was slightly alkaline, whereas maximum salinity was found at site 4. The TDS, EC, and turbidity at site 5 were found to be the highest among the studied sites. Further, water samples were used to examine the cytotoxic and genotoxic effect of pollutants in the root tip cells of *Allium cepa* after three and seven day's growth. There was a sharp decline in root length and root number down stream. Moreover, the squash preparations showed significant abnormalities; at the cellular level, cell shape and sizes show undesirable changes. At nuclear level binucleate cells, lobulated nuclei, micronuclei at site 3, 4, and 7 were recorded. The chromosomal abnormalities included chromosomal bridges, chromosomal loss, and abnormal orientation at different sites. This report is a cause for significant concern as the River Yamuna is Delhi's primary source of water supply for domestic, agricultural, industrial, energy, and many other purposes.

Key words | chromosomal adherence, chromosomal bridge, cytotoxic, genotoxic, laggards, micronucleus

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HIGHLIGHTS

- The experiment was carried out in Delhi, the capital city of India, which is one of the largest and most polluted cities of the world.
- We categorized the effects of polluted water in three categories of abnormal images namely cellular, nuclear and chromosomal.
- To the best of our knowledge, we reported cell size and abnormal cellular images of *Allium cepa* root tips grown in polluted water for the first time.
- The damaging effects on the *A. cepa* root tip cells could be used as an indicator of the possible damaging effects of polluted Yamuna river water on crops from the health point of view as well.

INTRODUCTION

Population explosion together with human interference and industrialization has resulted in the emergence of serious new environmental problems at a global scale. Climate change has brought with it extremes of rains, floods, pollution and eventual scarcity of potable water on the planet earth. Population explosion is resulting in increased requirements, enormous waste generation and disposal leading to pollution of water bodies. Water intensive agricultural

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Case Study

Incredible Role of Spices in Diet – An Indian Perspective

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A B S T R A C T

Traditional medicines involve the use of herbs and plant extracts for the treatment of diseases. Right from scriptures to the current literature, herbs have carved and retained their spot as health boosters. The rise of drug resistance to antibiotics has been acting as a catalyst in capturing the interest of scientists globally to develop new medical healing models using plant-based products. Also, owing to the diverse medicinal properties and economic value of plants, there has been an increment in research studies related to their uses as food supplements. Indian cuisines seasoned with spices are therapeutic foods, as they are the cheapest source of bioactive phytochemicals essential for nutrition. Spices possess antimicrobial and antioxidant properties that have proven health benefits and can be exploited to even combat very serious ailments related to heart, lungs, stomach, skin, eyes etc. Phytonutrients present in spices are excellent therapeutic molecules and are essential for the very sustenance of healthy life. This review comprehends the multiple therapeutic potentials of spices of Bharat Ki Rasoi (Indian kitchen) in curing various health issues.

***Key words*:** Traditional medicine, Spices, Aromatic, Seasoning, Therapeutic effects, *Bharat Ki Rasoi*

Indian culture documents the significance of plants in the system of medicine to meet the global health care needs since time immemorial. Such knowledge about plants compels us to look for ways to incorporate more plants and plant-based products in our diet and as medicine. These natural products have no side effects and most importantly, they work to remove the cause of the disease and not just the symptoms.

The present review article explores the research studies undertaken to exploit the benefits of spices by evaluating their healing and therapeutic properties. All the spices discussed in the literature till date have been proven to have excellent healing properties. However, none of the research studies were able to provide a plant-based healing strategy against the Coronavirus disease (COVID-19). An important point to note is that even though plant-based healing systems do not promise a curative method, they can be judiciously utilized to control the additional symptoms that come with the viral infections; especially in cases of patients with compromised immunity. Spices have been included in the diet not only for aroma but also for their underlying role in boosting the average human health and immunity. It has been reported that, populations with higher consumption of spices show correspondingly lesser number of people affected by COVID-19 [1]. However, there are reports that spices can pose risk to human health due to the presence of chemical hazards such as plant toxins (aflatoxins), pesticides, heavy metals, dyes etc. [2]. The manuscript provides general information about use of spices in the diet, using very authentic and well-published studies along with key mention of prevalent and popular home remedies.

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Spices from the Indian kitchen

Today, the world is gravitating towards green economy and plant-based healing strategies and India has been practicing these potent healing systems from ages. Spices are truly an integral part of Indian cuisine. The importance that is given to spices in Indian cooking is unparalleled. Spices are extensively used in cooking, not just for enhancing visual and aromatic appeal, but because of their health benefits too. Home remedies employ a combination of herbs and spices, which may be used in a form of a paste, powder or even concoction. The most colourful and aromatic area in the Indian kitchen is undoubtedly the spice rack which plays an integral role in the Indian Cuisine. Well-labelled and colourful spice containers have been the authenticity of *Bharat Ki Rasoi* (Indian kitchen).

In the present review article uses of spices have been described into five groups:

1. *Spices commonly used for tempering in dishes and their medicinal properties*

Chilli Pepper, Bay Leaf, Cumin, Mustard and Asafoetida

Indian dishes can never be called complete without a tempering. It forms the base of almost all dishes in the Indian cuisine. The diverse combinations of tempering originate from different Indian states. Out of all the vast varieties of spices, there is a handful of them that are used more often than the others. Bioactive compounds present in spices are responsible

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Assessment of Heavy Metals in Ground Water of Different Locations of National Capital Region, Delhi, India

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Abstract

The quality of ground water in any region of the world entirely depends on different types of chemical constituents and their concentration levels in surrounding environment or dissolved in water. The main aim of this study was to assess some basic hydro-chemical parameters and heavy metals in ground water of National Capital Region (NCR), India. Thus, we have collected ground water samples from different sources viz., Najafgarh (NG), Bindapur (BP), Dwarka (BC and BG), Uttam Nagar (UN)and Sonipat (SP) in the NCR and analyzed electrical conductivity (EC), total dissolved solids (TDS), salinity, Arsenic (As), Chromium (Cr), Copper (Cu), Cadmium (Cd), Nickel (Ni), Zinc (Zn), and Lead (Pb). The values of EC, TDS and salinity across the study sites range from 0.32 to 11.41 mS/cm, 233 to 8100 ppm and 154 to 6310 ppm respectively. Whereas, the mean level of heavy metals ion concentration in ground water was in the sequence of Zn> Ni > Cr > Pb > As > Cu > Cd across the study sites. It has been concluded that, except for Uttam Nagar, ground water from all study sites is contaminated with heavy metals like Zn, Ni, Cr, Pb and As. Therefore, the ground water from study sites that are polluted is unfit for drinking purpose and may pose health risks.

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Received: 05 October 2020
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Keywords
Ground Water; Hydro-Chemical Parameters; Heavy Metals; National Capital Region; Human Health.

Introduction

Heavy metals contamination in ground water is a major problem across the world. Heavy metals are naturally present in the ecosystems. However, in recent decades the heavy metal concentration levels are increasing in ground water, river and

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Journal of Basic Microbiology

RESEARCH PAPER

Study of As-resistant bacteria from Nadia, India and a survey of two As resistance-related proteins

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Abstract

The present investigation deals with the characterisation of three As-resistant bacteria, *Bacillus aryabhattai* strain VPS1, *Bacillus licheniformis* strain VPS6 and *Sporosarcina thermotolerans* strain VPS7 isolated from the rhizosphere of a contaminated paddy field in Chakdaha, Nadia, West Bengal, India. Two strains, VPS6 and VPS7 showed ureolytic activity, which can be used for microbial-induced calcite precipitation of As as a bioremediation option. However, As reduction and oxidation capacities were not reported in any of these bacteria. A phylogenetic tree of 16S ribosomal RNA gene sequences was constructed for all three bacterial isolates, including different species of As-resistant *Bacillus* and *Sporosarcina*. Furthermore, literature survey and genome mining were employed to explore the diversity of As resistance-related proteins, arsenite S-adenosylmethyltransferase (ArsM) and arsenical pump membrane protein (ArsB) among different bacteria, and the phylogenetic relatedness was studied to understand the distribution and evolution of their amino acid sequences. ArsB was predominantly present in a wide variety of bacteria (347 taxa); however, ArsM was reported in comparatively fewer isolates (109 taxa). There were a total of 60 similar taxa that contained both ArsM and ArsB. Both proteins were most abundantly present in phylum Proteobacteria. Overall, this investigation enumerates As-resistant bacteria to understand the As metabolism in the environment, and the phylogenetic analysis of As resistance-related proteins helps in understanding the functional relationship in different bacteria for their role in As mobility in the environment.

KEYWORDS

arsenic, arsenical pump membrane protein, arsenite S-adenosylmethyltransferase, As-resistant bacteria, bacteria

1 | INTRODUCTION

Arsenic (As) is a potent carcinogen and neurotoxin [1]. In nature, As predominantly exists as As(III) and As(V), and the former state is more toxic than the latter one. Both natural and anthropogenic activities are responsible for As contamination in the environment, of which, microbial colonisation and weathering of rock and volcanic eruption are the main processes in spreading As contamination [2,3]. However, mining, smelting, combustion of fossil fuels, production of glass and semiconductors, fertilisers and chemotherapeutics drug of cancer are some anthropogenic causes for As release in the environment. In the global scenario, a population of more than 150 million people in around 70 countries are at risk of being exposed to elevated levels of As [4,5].

Environmental Science and Pollution Research
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REVIEW ARTICLE

Bioremediation of toxic heavy metals (THMs) contaminated sites: concepts, applications and challenges

Zeeshanur Rahman[1,2] · Ved Pal Singh[2]

Received: 10 December 2019 / Accepted: 15 April 2020

Abstract

Heavy metal contamination is a global issue, where the prevalent contaminants are arsenic (As), cadmium (Cd), chromium (Cr)(VI), mercury (Hg), and lead (Pb). More often, they are collectively known as "most problematic heavy metals" and "toxic heavy metals" (THMs). Their treatment through a variety of biological processes is one of the prime interests in remediation studies, where heavy metal-microbe interaction approaches receive high interest for their cost effective and ecofriendly solutions. In this review, we provide an up to date information on different microbial processes (bioremediation) for the removal of THMs. For the same, emphasis is put on oxidation-reduction, biomineralization, bioprecipitation, bioleaching, biosurfactant technology, biovolatilization, biosorption, bioaccumulation, and microbe-assisted phytoremediation with their selective advantages and disadvantages. Further, the literature briefly discusses about the various setups of cleaning processes of THMs in environment under ex situ and in situ applications. Lately, the study sheds light on the manipulation of microorganisms through genetic engineering and nanotechnology for their advanced treatment approaches.

Keywords Bioremediation · Biotechnology · Environment · Microorganisms · Toxic heavy metals

Introduction

Increasing load of heavy metal contamination has brought many severe deteriorating outcomes for our environment. Among various heavy metal contamination, presence of arsenic (As), cadmium (Cd), chromium (Cr)(VI), mercury (Hg), and lead (Pb) in environment has received more attention than any other heavy metals because they are non-threshold toxins and present in much higher concentrations in aerial, terrestrial, and aquatic systems from their critical values set by various international agencies (ATSDR 2015; Pure Earth 2015; WHO 2010). More often, they are termed as "most problematic heavy metals" and "toxic heavy metals" (THMs) (Rahman and Singh 2019). Recent data estimate that Cd, Cr, Hg, and Pb from various anthropogenic activities pose an outsized threat to collectively 66 million people from all over the world (Pure Earth 2015). Moreover, As contamination in drinking water alone has affected more than 150 million people in different parts of the world (Ravenscroft et al. 2009). Each THM owing to its special properties has different ability to influence the environment and its organisms. The study of the interaction of heavy metals with environment is a vast topic and therefore, their discussion is out of scope for this paper. However, the detailed understanding about their special characteristics, sources, and contamination and impact on different natural systems can be undertaken from another review article elsewhere (Rahman and Singh 2019).

Removal of THMs from contaminated sites is a challenging task for the protection of environment. Their treatment is handled by four different ways viz. in situ containment, in situ treatment, ex situ containment, and ex situ treatment (Palermo et al. 1998; Wang et al. 2004). Based on the used methods, the removal process can be classified into three broad categories (i) chemical, (ii) biological/biochemical, and (iii) physicochemical approaches (Hashim et al. 2011). These processes comprise various techniques including stabilization/solidification (S/S), capping, dredging, natural attenuation, oxidation-reduction, precipitation, volatilization, vitrification, physical exclusion, thermal desorption, soil washing, coagulation-filtration, solid-liquid separation,

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REVIEW

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Recent developments in the nanomaterial-catalyzed green synthesis of structurally diverse 1,4-dihydropyridines

Ritu Mathur,[a] Khushal Singh Negi,[b] Rahul Shrivastava [b] and Rashmy Nair *[c]

1,4-Dihydropyridine (1,4-DHP), a privileged heterocyclic scaffold, has been extensively utilized in various biological and therapeutic applications. In this review article, we discussed the role of different nano-catalysts, nanoflakes, nanocomposites, and other green-supported nanomaterials in the synthesis of a biologically active and vital pharmaceutical precursor 1,4-DHP and its derivatives such as polyhydroquinoline, benzopyranopyridines, and dihydropyridine since 2015. It is evident that although the use of various tailored nanostructures under different conditions to optimize the synthesis of 1,4-DHP and its compounds has provided sustainable and efficient proposals, yet the development of greener practices in the synthesis of 1,4-DHPs, which can be applied to design new synthetic routes and sequences in process development, is a far-reaching task to be accomplished.

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Introduction

The increased awareness on the environment and climate-related issues has encouraged organic chemists to develop eco-compatible chemical processes incorporating the basic principles of green chemistry such as atom economy, non-toxic reactants, use of benign solvent, and efficient catalyst. Among the different aspects of a green chemical process, the utilization of an effective non-toxic catalyst has played a pivotal role in the designing of green and sustainable chemical transformations owing to the capability of the catalyst to reduce the temperature, pressure, and reagent-based waste along with the enhancement of the selectivity of a reaction, which potentially circumvents unwanted side reactions.[1] Catalysis through nanomaterials has been proven to be an attractive approach to frame greener chemical pathways, based on their unique features such as a larger reactive surface to volume ratio with higher sensitivity and selectivity, milder reaction conditions, and possibility of recycling and reusing the catalyst. It has been observed that nanomaterials have collective merits of both heterogeneous and homogeneous catalytic systems. Higher surface area allows facile contact between reactants, making the nano-catalyst behave like a homogeneous catalyst, whereas being insoluble in the reaction mixture, it acts similar to a heterogeneous

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Geochemical Signatures and Chemical Toxicity Assessment of Groundwater Uranium in the Agricultural Dominated Tehsil after Indian Summer Monsoon

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Abstract
The present study deals with the determination of uranium in drinkable groundwater samples by LED fluorimeter, contour analysis, PCA analysis and chemical toxicity assessment. The concentrations were found to be between 0.11 to 39.76 ppb with an average of 4.78 ppb. 7.14 % of samples exceed the WHO limits (30 ppb).

The calculated maximum hazard quotient was 0.64 which lies in the safe range value. Mean LADD was observed as 0.35 and 0.28 µg/kg per day in adults and children respectively which are less than the AERB prescribed limit of 4.53 µg/kg per day. Contour and PCA analysis shows that the ORP and fluoride were the driving factors of uranium in the studied area.

Keywords: Uranium, PCA, Contour, Gunnaur.

Introduction

Indian Summer Monsoon (ISM) has been known as a backbone for the agriculture of the Indian states. It contributes to the rain fed and groundwater recharge in the months of June to September. However, if yearly calculated, rate of groundwater recharge is less than the rate of groundwater depletion. The groundwater, country wise, accounts for 40 to 50% of the irrigation and 50 to 80% of the domestic water use[16,20]. Nowadays groundwater is decreasing across the country[10]. A study reported loss of 109 km^3 groundwater from four north Indian UT/states (Delhi, Rajasthan, Punjab and Haryana), which was more than the country largest surface-water reservoir capacity[24].

Extraction of groundwater through illegal bore wells at unrestricted rates results to downfall of water level at pre-monsoon stage. However, when ISM arrives, it slowly recharges the aquifers and also leads to change in groundwater chemistry. Groundwater chemistry is influenced by several factors such as wastewater irrigation[14], urban sewage, excess pumping, domestic and industrial wastes etc. Due to complexity of anthropogenic and geogenic factors, it is difficult to identify influencing process of groundwater chemistry for a particular element.

Various researchers used Piper plots[23], Durov plots[23], Gibbs diagram[25], Wilcox diagram[13], Chadha diagram[19], ionic delta analysis, chemical mass balance and saturation indices for understanding groundwater chemistry of major ions. In addition to major ions, presence of many hazardous elements in groundwater were reported such as arsenic, lead and uranium.

Uranium is known for its chemical and radiological toxicity. Dissolution of the uranium-bearing minerals contributes uranium in groundwater. Various geogenic and anthropogenic factors affect the mobility of the uranium. In past few years, many researchers claimed that chemical phosphate fertilizers also contained uranium[29]. In groundwater, uranium prevails in +4 and +6 oxidation states[7]. In the +6 oxidation state, uranium is more soluble in water[18]. Uranium's complex chemistry with other ions making it difficult to predict uranium behavior in natural environment. Many studies[8] used multi-variate analysis for such complex environmental researches. One of the most reliable multivariate analysis method is Principal Component Analysis (PCA).

Principal component analysis simplifies the environmental complexity in data with comparatively small lower dimensional components called principal components. Selection of number of components may be decided from its scree plot, Eigen values or cumulative proportion value. Number of components before line trend in scree plot may be used as components. Components with Eigen values greater than 1 may be considered as components as per Kaiser criterion. Components that explain 80% of variance in cumulative proportion may be used for decision making. Present study was carried out with the objectives of measurement of uranium concentration, contour analysis, PCA analysis and chemical toxicity assessment of uranium in drinkable groundwater of Gunnaur tehsil after the Indian summer monsoon period.

Material and Methods

Study Area: The tehsil Gunnaur lies in western part of Uttar Pradesh state of India as shown in figure 1. It lies between latitudes 28.06 to 28.48 N and longitudes 78.28 to 78.67 E. It covers area of 950 sq. km and is located at bank of river Ganga. Land use pattern was analyzed by Indian Geo-platform of ISRO i.e. Bhuvan. The area is double crop agricultural dominated as shown in figure 1. The small sized built up areas are present across the tehsil whereas a dense built up area is present near the center which is the town area of the tehsil. The area has population of 5,54,275 in 2011[9].

Terrestrial Gamma Radiation Dose (TGRD) Environmental Distribution in Alluvial Soil Region, its Monsoonal Variation and Assessment of Lifetime Cancer Risk

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Abstract

Present study aimed to measure GIS based annual effective dose (AED) and to assess the associated health risk from outdoor terrestrial gamma radiation dose (TGRD) in alluvial soil region of Etah and Hathras districts of Uttar Pradesh in India. Total 252 sample doses were measured using the Geiger Muller tube based survey meter. 126 sample doses were measured in pre-monsoon season at different grids of study region and 126 sample doses were measured in post-monsoon season at the same grids.

From the TGRD values, AED and excess lifetime cancer risks (ELCR) were calculated by standard methods. Results showed that TGRDs varied from 64 to 195 nSv/h and 70 to 219 nSv/h in pre-monsoon and post-monsoon season respectively for the 7 tehsils of the study region. Calculated mean AED ranged between 0.148 to 0.169 mSv/y in pre-monsoon season and 0.122 to 0.163 mSv/y in post-monsoon season. Calculated mean ELCR of tehsils was found in the range of 0.556 × 10^{-3} to 0.634 × 10^{-3} and 0.459 × 10^{-3} to 0.613 × 10^{-3} in pre and post-monsoon season respectively. The TGRDs, calculated AED and ELCR were found higher than the world average value and show high variations with monsoon.

Keywords: Gamma Radiation, GIS, Etah, Hathras.

Introduction

Radiation is an inescapable thing for the living beings. Humans are exposed to it throughout the life. However, doses and dose rates are variable depending on the several factors such as place of residence, sex[2], age, lifestyle etc. It may be internal, external or combination of it which produces a joint dose distribution for different body parts.

Based on sources, radiation is classified as anthropogenic and natural radiation. Anthropogenic radiation includes radiation from nuclear weapons, nuclear power plants[12], uranium mining and milling[32], fertilizers[3], cigarettes[18], medical facilities[11] and natural radiation includes radiations from soil, vegetation etc.

Based on sources, natural radiation is further classified as internal, cosmic and terrestrial. Internal radiation includes radioactive potassium-40[28], carbon-14[33], lead-210[21] present in human bodies. Cosmic radiation was caused by interaction of charged particles from the sun and stars with the earth's atmosphere and magnetic field. Terrestrial radiation exposure is known to be the significant source of public exposure to ionizing radiation. Geological formations, soil types, rainfall, drainage patterns and man-made activities are the important factors affecting terrestrial radioactivity. Terrestrial radiation exposures arise mainly from the primordial radionuclide such as ^{238}U, ^{226}Ra, ^{232}Th and ^{40}K. These radionuclides are found on the earth which came into existence with the creation of the planet and they may lead to toxicity[16].

These are present in almost all geological materials in our environment. These radionuclide are carried to the soils, streams and rivers by rain because of rock weathering. Presence of radionuclide in earth crust may be estimated by recording natural gamma radiation in that particular area. The levels of radioactive nuclides in rock, soil and groundwater vary with the geological locations; therefore, it is important to measure the dose rates at different geological areas.

The aim of the present study was to measure the environmental distribution of TGRD, its monsoonal variation and calculation of annual effective dose and lifetime cancer risk for the residents in the alluvial soil region of the Etah and Hathras districts lying in the central region of Yamuna-Ganga doab.

Material and Methods

Study Area: Etah and Hathras districts are adjacent to each other and the region is located in the western part of the Uttar Pradesh state as shown in figure 1. The study district Etah is located between latitudes 27.27 to 27.77 N and longitudes 78.17 to 79.28 E and district Hathras is located between latitudes 27.30 to 27.83 N and longitudes 77.88 to 78.53 E. The total geographical area of the study region is approx 4,250 sq. km and total population was 25,03,061 in 2011[5]**.** The studied region is agriculture dominated area with intensive use of fertilizers. This alluvial soil region lies in central Ganga-Yamuna doab.

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Review

Chitin and its derivatives: Structural properties and biomedical applications

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ABSTRACT

Chitin, a polysaccharide that occurs abundantly in nature after cellulose, has attracted the interest of the scientific community due to its plenty of availability and low cost. Mostly, it is derived from the exoskeleton of insects and marine crustaceans. Often, it is insoluble in common solvents that limit its applications but its deacetylated product, named chitosan is found to be soluble in protonated aqueous medium and used widely in various biomedical fields. Indeed, the existence of the primary amino group on the backbone of chitosan provides it an important feature to modify it chemically into other derivatives easily. In the present review, we present the structural properties of chitin, and its derivatives and highlighted their biomedical implications including, tissue engineering, drug delivery, diagnosis, molecular imaging, antimicrobial activity, and wound healing. We further discussed the limitations and prospects of this versatile natural polysaccharide.

Contents

Abbreviations: BBB, blood-brain barrier; BFG, bael fruit gum; CDs, carbon dots; CN, chitin nanofibril; CNP, Nanoparticles synthesized from chitosan; CS, chitosan; CTWK, chitin whisker; DA, Degrees of acetylation; DCA-PCCs, chitosan derivative-based nanocarrier; DOX, doxorubicin; DS, dextran; HAp, hydroxyapatite; LBL, layer-by-layer self-assembly; NHL, non-Hodgkin lymphoma; NPs, nanoparticles; *O*-HTCC, ammonium-quaternary derivative of chitosan; QDs, quantum dots; RS, Resol resin; SF, silk fibroin; SK, Shish-kebab.

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Polycarbazole-multiwalled carbon nanotubes based nanocomposite: Synthesis, spectral, biocidal and Acetaldehyde sensing studies

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Maintaining Mindfulness in Organizations; Practice of Mindfulness Promote Lead to Creation of a Learning Organization

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Abstract

In this paper, the authors explore the breakthrough of human consciousness and how mindfulness practice immensely contributes to this endeavor. They discuss the inherent problem of the contemporary workplace: the pain and suffering; physiologically, psychologically, and emotionally, due to myriad reasons, such as incivility, mismanagement of change, unhealthy competition and the consequential breakdown of relationships, leading to a weakening of the socio-biological immune-system. The paper then attempts to prove that mindfulness practice opens the possibilities for healing by cultivating humane qualities such as compassion, kindness, and the promotion of physio-psychological well-being. Thereby, argues that mindfulness practice improves cognitive functions, collective inquiry by unearthing one's internal picture of the world, and ushering a new level of consciousness, which may pave a pathway toward creating a learning organization.

Keywords

Mindfulness, Aperspectival, Meta-awareness, Learning Organization, Consciousness, Integral, socio-biology

Introduction

Jean Gebser (1985) in "The Ever-Presence Origin" demonstrated the evolution of human consciousness, call "mutation" of consciousness, where he mapped human evolution of consciousness into successive stage or structures; The Archaic, The Magic, The Mythical, The Mental and The Integral. This progression proceeds from formless, spaceless, timeless indiscriminate worldview to perspectival worldview (multi-dimensional), to aperspectival worldview (integral) in which we begin to look at the world in integral wholeness (1985, p. 36-102). This progression of consciousness is conceived in successive stages (Gebser, 1985; Wilber, 2000; Laloux, 2014). However, Gebser believed, organization can experience the presence of multi-stage of consciousness simultaneously. One department may be in 'Mental' (follow predict and control approach), whereas, others may run seemingly closer to "Integral" (sense and respond approach) (Gebser, 1985; Laloux, 2014). In closer look, such drastic difference is intrinsically driven by an individual's level of consciousness who is heading the department or organization. This level of consciousness of an individual strongly determines their relationship toward each other. Therefore, an individual's consciousness level reshapes their work engagement, their interaction with others at the workplace.

According to Frederic Laloux (2014), each stage of consciousness gives birth to a new model of management which is much superior to the former. Arie De Geus (1999), Ken Wilber (2000), Frederic

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ORIGINAL RESEARCH PAPER

Remediation of ozone pollution by ornamental plants in indoor environment

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ABSTRACT

The indoor air quality is much more matter of concern as relative to ambient or outdoor air quality, especially in the context of human health. However, very few studies have been reported for remediation of indoor ozone by plant species. The main objective of this study is to evaluate ozone deposition velocities and ozone removal effectiveness of three indoor ornamental plant species (*Dracaena deremensis*, *Tagetes erecta* and *Lilium candidum*) that can be used in the remediation of indoor ozone. Ozone deposition velocity was estimated through measurement of leaf surface areas of selected plant species and exposing them to 3-regular daytime cycles where ozone concentrations under controlled conditions first increased from 8 h followed by 16 h in the absence of ozone. Values of ozone deposition velocity after the completion of first exposure were found maximum (7.7 m/h) in case of *Dracaena deremensis and* minimum *(*0.5 m/h) after the completion third exposure in *Lilium candidum.* The ozone removal effectiveness found in the range of 0.7 to 13% for leaf surface area to room volume ratio of 0.06/m with reference to an air exchange system and background loss present in an indoor environment. Among the selected plant species, *Dracaena deremensis* has got the highest ozone deposition velocity as well as ozone removal effectiveness and *Lilium candidum* has got the lowest values. Hence, this study concludes with the sustainable use of ornamental plant species in the remediation of the indoor ozone pollution, which can further help in improving the health condition of the residents.

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Comments on "The Solution of a Mathematical Model for Dengue Fever Transmission Using Differential Transformation Method: J. Nig. Soc. Phys. Sci. **1** (2019) 82-87"

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Abstract

The mathematical model for dengue fever transmission studied by [1], has been re-investigated. The differential transformation method (DTM) is used to compute the semi-analytical solutions of the non-linear differential equations of the compartment (SIR) model of dengue fever. This epidemiology problem is well-posed. The effect of treatment as a control measure is studied through the growth equations of exposed and infected humans. The inadvertent errors in the recurrence relations (DTM) of equations for dengue disease transmission including initial conditions have been removed. Furthermore, the semi-analytic solutions of the model are obtained and verified with the built-in function `AsymptoticDSolveValue` of Wolfram Mathematica. It has been found that results obtained from the DTM are valid only for small-time t ($t < 1.5$), as t becomes large, the human population (exposed and recovered) and infected vector population become negative.

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1. Introduction

Dengue fever is a mosquito-borne flavivirus that is mostly found in tropical and sub-tropical regions of the world. The disease is spread by Aedes mosquito due to day-biting [2]. Dengue fever is the fastest-spreading vector-borne viral disease affecting 40 per cent of the world's population, and now endemic in over 100 countries. Over the last two decades, the number of dengue cases registered to WHO has increased from 505,430 cases in 2000 to over 2.4 million in 2010, and 4.2 million in 2019. Between 2000 and 2015, the number of registered deaths increased from 960 to 4032 [3]. A second potential vector, Aedes Albopictus, resides in temperate regions (North America and Europe), where it may give rise to occasional dengue outbreaks [4, 5].

The spread of infectious diseases is studied through various epidemiological models, including observational studies, interventional studies apart from mathematical modelling using the compartment model [6]. The pioneering work using the SIR model for contagious diseases is done by [7, 8, 9]. In the compartment model, the population is primarily divided into three distinct mutually exclusive compartments: susceptible $S(t)$, infected/infectious $I(t)$ and recovered $R(t)$ at any

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ON THE STABILITY AND GENERAL SOLUTION OF A SUM FORM FUNCTIONAL EQUATION EMERGING FROM INFORMATION THEORY

DHIRAJ KUMAR SINGH, SHVETA GROVER

Abstract. In this paper we intend to obtain the general solutions of a sum form functional equation containing two unknown mappings followed by discussing the criteria of stability for the same. Some of these solutions are related to entropies of type (α, β) proposed by Behara and Nath [3].

1. Introduction

For $n = 1, 2, \ldots$: let

$$\Gamma_n = \left\{ (p_1, \ldots, p_n);\ p_i \geq 0,\ i = 1, \ldots, n;\ \sum_{i=1}^{n} p_i = 1 \right\}$$

denote the set of all n-component discrete probability distributions. Let $\mathbb{R}$ denote the set of real numbers; I denote the closed unit interval $[0, 1]$, i.e. $I = \{x \in \mathbb{R} : 0 \leq x \leq 1\} = [0, 1]$.

In this paper, the research methodology includes not only adding new dimensions to the field of research work but it also includes efforts to establish a connect between two existing dimensions that is Functional Equations and Information Theory. Indeed one of the intriguing branches which are explored in the domain of functional equations with reference to information theory is to discover and study those functional equations that are used to characterize several entropies.

An entropy which is referred as uncertainty in information theory (Ash [2]) was introduced by Shannon [15]. For a probability distribution $(p_1, \ldots, p_n) \in \Gamma_n$, the Shannon entropy is defined as:

$$H_n(p_1, \ldots, p_n) = -\sum_{i=1}^{n} p_i \log_2 p_i \tag{1.1}$$

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Key words and phrases. Sum form functional equation; additive mapping; logarithmic mapping; bounded mapping; the entropies of type (α, β); stability of a functional equation.

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where $H_n : \Gamma_n \to \mathbb{R}$, $n = 1, 2, \ldots$ and the convention $0 \log_2 0 := 0$ is adopted. Chaundy and McLeod [4] with reference to some statistical thermodynamical problem came across the functional equation

$$\sum_{i=1}^{n}\sum_{j=1}^{m} f(p_i q_j) = \sum_{i=1}^{n} f(p_i) + \sum_{j=1}^{m} f(q_j) \tag{1.2}$$

where f is a real valued mapping with domain I; $(p_1, \ldots, p_n) \in \Gamma_n$, $(q_1, \ldots, q_m) \in \Gamma_m$. Moreover, they proved that if $f : I \to \mathbb{R}$ is presumed to be a continuous mapping satisfying the functional equation (1.2) and is valid for all $n,\ m = 1, 2, \ldots$, then f is of the form

$$f(x) = -cx \log_2 x \tag{1.3}$$

where c is an arbitrary real constant. With the help of (1.3) it can be concluded that the functional equation (1.2) plays a key role in characterizing Shannon entropies given by (1.1). This paper [4] added a new aspect in the field of functional equations unfolding from information theory known as "Sum form functional equations emerging from information theory".

Behara and Nath [3] generalized the notion of Shannon entropy given by (1.1) by introducing the entropies of type (α, β). For a probability distribution $(p_1, \ldots, p_n) \in \Gamma_n$, entropy of type (α, β) is defined as:

$$H_n^{(\alpha,\beta)}(p_1, \ldots, p_n) = \begin{cases} (2^{1-\alpha} - 2^{1-\beta})^{-1} \left(\sum\limits_{i=1}^{n} p_i^{\alpha} - \sum\limits_{i=1}^{n} p_i^{\beta} \right) & \text{if } \alpha \neq \beta \\ -2^{\beta-1} \sum\limits_{i=1}^{n} p_i^{\beta} \log_2 p_i & \text{if } \alpha = \beta \end{cases} \tag{1.4}$$

where $H_n^{(\alpha,\beta)}$ is a real valued mapping with domain Γ_n, $n = 1, 2, \ldots$; α and β are fixed positive real powers such that

$$0^{\alpha} := 0, 0^{\beta} := 0, 1^{\alpha} := 1, 1^{\beta} := 1 \tag{1.5}$$

and $0^{\beta} \log_2 0 := 0$. This phenomenon of entropies of type (α, β) represented by (1.4) initiated the study of the functional equation

$$\sum_{i=1}^{n}\sum_{j=1}^{m} f(p_i q_j) = \sum_{i=1}^{n} p_i^{\alpha} \sum_{j=1}^{m} f(q_j) + \sum_{j=1}^{m} q_j^{\beta} \sum_{i=1}^{n} f(p_i) \tag{1.6}$$

where $f : I \to \mathbb{R}$; $(p_1, \ldots, p_n) \in \Gamma_n$, $(q_1, \ldots, q_m) \in \Gamma_m$; α and β are fixed positive real powers which satisfy the conventions stated in (1.5).

Behara and Nath [3] were first to discover the continuous solutions of the functional equation (1.6) assuming that $\alpha > 0$, $\beta > 0$ and for all $n = m = 1, 2, \ldots$. The functional equation (1.6) was also studied by Kannappan [8], [9] who obtained its integrable and measurable solutions by imposing some assumptions on the mapping $f : I \to \mathbb{R}$.

Finally, without imposing any regularity condition on the real valued mapping $f : I \to \mathbb{R}$, Losonczi and Maksa [11] found the general solutions of (1.6) for fixed integers $n \geq 3$, $m \geq 2$ with $\alpha \neq 1$, $\beta \neq 1$. The functional equation (1.6) was readdressed by Kocsis and Maksa [10] who examined the stability of the same. The problem of stability was raised for the first time by S.M. Ulam [17]. For the problem of stability concerning functional equations, we refer to the survey paper of Hyers and Rassias [7].

The objective of this paper is to explore the general solutions of the functional equation

$$\sum_{i=1}^{n}\sum_{j=1}^{m} f\left(p_i q_j\right) = \sum_{i=1}^{n} p_i^{\alpha} \sum_{j=1}^{m} h(q_j) + \sum_{j=1}^{m} q_j^{\beta} \sum_{i=1}^{n} h\left(p_i\right) \tag{A}$$

where f and h are unknown real valued mappings each having the domain I; $(p_1, \ldots, p_n) \in \Gamma_n$, $(q_1, \ldots, q_m) \in \Gamma_m$; $n \geq 3$, $m \geq 2$ be fixed integers; $0 < \alpha \in \mathbb{R}$, $0 < \beta \in \mathbb{R}$, such that $\alpha \neq 1$, $\beta \neq 1$ with (1.5). Now we mention the motivation behind studying (A). As far as we know, Nath and Singh [14] were the first who came across the functional equation (A) while addressing some other functional equation leaving it as an open problem. Equation (A) is a Pexiderized form of (1.6) and it is useful in characterizing entropies of type (α, β). It follows that functional equation (A) is emerging from information theory, thus connecting two aforementioned branches. This provides us the motivation to study functional equation (A). Furthermore, we discuss the problem of stability of functional equation (A) for the fixed integers $n \geq 3$, $m \geq 3$. The problem of stability of the functional equation (A) in the sense of Hyers and Rassias [7] is given along the following lines:

Let $n \geq 3$, $m \geq 3$ be fixed integers and $0 \leq \varepsilon \in \mathbb{R}$ be fixed. Find all the mappings $f : I \to \mathbb{R}$, $h : I \to \mathbb{R}$ satisfying the functional inequality

$$\left| \sum_{i=1}^{n}\sum_{j=1}^{m} f(p_i q_j) - \sum_{i=1}^{n} p_i^{\alpha} \sum_{j=1}^{m} h(q_j) - \sum_{j=1}^{m} q_j^{\beta} \sum_{i=1}^{n} h(p_i) \right| \leq \varepsilon \tag{B}$$

for all $(p_1, \ldots, p_n) \in \Gamma_n$, $(q_1, \ldots, q_m) \in \Gamma_m$.

This paper is divided into five sections. In next section 2, we mention some preliminary results which will be used in the subsequent sections. In section 3, the general solutions of the functional equation (A) are obtained for the fixed integers $n \geq 3$, $m \geq 2$. In section 4, the problem of stability of the functional equation (A) is being examined for the fixed integers $n \geq 3$, $m \geq 3$. In section 5, we discuss the significance of the functional equation (A) from the perspective of the information theory.

2. Some Preliminary Results

In this section, we state some known definitions and results.

A mapping $a : I \to \mathbb{R}$ is said to be additive on I or on the unit triangle

$$\Delta = \{(x, y) : 0 \leq x \leq 1, 0 \leq y \leq 1, 0 \leq x + y \leq 1\}$$

if it satisfies the equation $a(x + y) = a(x) + a(y)$ for all $(x, y) \in \Delta$. A mapping $A : \mathbb{R} \to \mathbb{R}$ is said to be additive on $\mathbb{R}$ if it satisfies the equation $A(x + y) = A(x) + A(y)$ for all $x \in \mathbb{R}$, $y \in \mathbb{R}$. It is known [5] that if a mapping $a : I \to \mathbb{R}$ is additive on I, then it has a unique additive extension $A : \mathbb{R} \to \mathbb{R}$ in the sense that A is additive on $\mathbb{R}$ and $A(x) = a(x)$ for all $x \in I$.

A mapping $\ell : I \to \mathbb{R}$ is said to be logarithmic on I if $\ell(0) = 0$ and $\ell(xy) = \ell(x) + \ell(y)$ for all $x \in]0, 1]$, $y \in]0, 1]$.

Result 2.1 ([12]). *Let $n \geq 3$ be a fixed integer and $\psi : I \to \mathbb{R}$ be a real valued mapping on I satisfying the equation $\sum_{i=1}^{n} \psi(p_i) = c$ for all $(p_1, \ldots, p_n) \in \Gamma_n$; c a given real constant. Then there exists an additive mapping $a_1 : \mathbb{R} \to \mathbb{R}$ such that $\psi(p) = a_1(p) - \frac{1}{n}a_1(1) + \frac{c}{n}$ for all $p \in I$.*

Result 2.2 ([11]). *Suppose that the mapping $f : I \to \mathbb{R}$ satisfies the functional equation (1.6) where $\alpha \neq 1$, $\beta \neq 1$, $0^\alpha = 0^\beta = 0$ and $n \geq 3$, $m \geq 2$ are fixed integers. Then*

$$f(p) = C(p^\alpha - p^\beta) + a(p) \quad \text{if} \quad \alpha \neq \beta, p \in I \tag{2.1}$$

and

$$f(p) = p^\alpha \ell(p) + a(p) \quad \text{if} \quad \alpha = \beta, p \in I; \tag{2.2}$$

where $a : \mathbb{R} \to \mathbb{R}$ is an additive mapping with $a(1) = 0$ and $C \in \mathbb{R}$ is a constant, $\ell : I \to \mathbb{R}$ is a logarithmic mapping. Conversely, the mappings (2.1), (2.2) satisfy (1.6).

Result 2.3 ([11]). *Let $m \geq 2$ be a fixed integer and $H : I \to \mathbb{R}$ be a real valued mapping on I which satisfies the functional equation*

$$\sum_{j=1}^{m} \left\{ H\left(pq_j\right) - p^\beta H(q_j) - q_j^\beta H(p) \right\} = 0 \tag{C}$$

for all $p \in I$, $(q_1, \ldots, q_m) \in \Gamma_m$; $\beta \neq 1$ being a fixed positive real power satisfying the conventions (1.5). If $H(0) = H(1) = 0$, then $H(p) = p^\beta \ell(p)$ for all $p \in I$; $\ell : I \to \mathbb{R}$ is a logarithmic mapping.

Result 2.4 ([13]). *Let $n \geq 3$ be a fixed integer; $0 \leq \varepsilon \in R$ be fixed and $\phi : I \to \mathbb{R}$ be a real valued mapping on I satisfying the functional inequality $\left| \sum_{i=1}^{n} \phi(p_i) \right| \leq \varepsilon$ for all $(p_1, \ldots, p_n) \in \Gamma_n$. Then there exists an additive mapping $a_2 : \mathbb{R} \to \mathbb{R}$ and a bounded mapping $b : \mathbb{R} \to \mathbb{R}$ with $b(0) = 0$, $|b(p)| \leq 18\varepsilon$ such that $\phi(p) - \phi(0) = a_2(p) + b(p)$ for all $p \in I$.*

Result 2.5 ([18]). *If a real additive mapping f is bounded on an interval $[a, b]$, then it is linear, i.e. there exists a constant c' such that $f(p) = c'p$ for all $p \in \mathbb{R}$.*

Result 2.6 ([16]). *Let $0 \leq \varepsilon' \in \mathbb{R}$ be fixed and $H : I \to \mathbb{R}$ be a real valued mapping on I which satisfies the functional inequality*

$$|H(pq) - p^\beta H(q) - q^\beta H(p)| \leq \varepsilon' \tag{D}$$

for all $p \in I$, $q \in I$; $\beta \neq 1$ being a fixed positive real power satisfying the conventions (1.5). Then any solution of (D) is of the form $H(p) = p^\beta \ell(p) + \bar{b}(p)$ for all $p \in I$; $\ell : I \to \mathbb{R}$ is a logarithmic mapping and $\bar{b} : \mathbb{R} \to \mathbb{R}$ is a bounded mapping with $|\bar{b}(p)| \leq 4e\varepsilon'$ where e is the natural base of the logarithmic mapping.

3. The General Solution Of The Functional Equation (A)

The main result of this section is the following:

Theorem 3.1. *Let $n \geq 3$, $m \geq 2$ be fixed integers; α and β be fixed positive real powers different from 1 satisfying the conventions (1.5) and let $f : I \to \mathbb{R}$, $h : I \to \mathbb{R}$.*
(I) *If $\alpha = \beta$, then the pair (f, h) satisfies (A) if and only if there exist a logarithmic mapping $\ell : I \to \mathbb{R}$, the additive mappings $a_1, a_2 : \mathbb{R} \to \mathbb{R}$ with $(n-m)a_2(1) = 0$ and $\bar{c} \in \mathbb{R}$ such that*

$$\left.\begin{aligned} &(i) \quad f(p) = p^{\beta}\ell(p) + a_1(p) + 2\bar{c}p^{\beta} - \frac{1}{nm}a_1(1), \\ &(ii) \quad h(p) = p^{\beta}\ell(p) + a_2(p) + \bar{c}p^{\beta} - \frac{1}{n}a_2(1). \end{aligned}\right\} \tag{α_1}$$

(II) *If $\alpha \neq \beta$, then the pair (f, h) satisfies (A) if and only if there exist the additive mappings $a_3, a_4 : \mathbb{R} \to \mathbb{R}$ with $(n-m)a_4(1) = 0$ and $c \in \mathbb{R}$ such that*

$$\left.\begin{aligned} &(i) \quad f(p) = c(p^{\alpha} - p^{\beta}) + a_3(p) - \frac{1}{nm}a_3(1), \\ &(ii) \quad h(p) = c(p^{\alpha} - p^{\beta}) + a_4(p) - \frac{1}{n}a_4(1). \end{aligned}\right\} \tag{α_2}$$

Proof. Let us put $q_1 = 1$, $q_2 = \cdots = q_m = 0$ in (A). We obtain

$$\sum_{i=1}^{n} \{f(p_i) - [h(1) + (m-1)h(0)]p_i^{\alpha} - h(p_i)\} = n(1-m)f(0).$$

By Result 2.1, there exists an additive mapping $a : \mathbb{R} \to \mathbb{R}$ such that

$$f(p) = h(p) + [h(1) + (m-1)h(0)]p^{\alpha} + a(p) - \frac{1}{n}a(1) + (1-m)f(0) \tag{3.1}$$

for all $p \in I$. The substitution p = 0 in (3.1) and the use of the fact that a(0) = 0 gives

$$a(1) = n(h(0) - mf(0)). \tag{3.2}$$

From (3.1) and (3.2), after performing necessary calculation work, we obtain

$$f(p) = h(p) + [h(1) + (m-1)h(0)]p^{\alpha} + a(p) + f(0) - h(0). \tag{3.3}$$

From (A), (3.3) and (3.2), we get

$$\sum_{i=1}^{n}\sum_{j=1}^{m} h(p_iq_j) - \sum_{i=1}^{n} p_i^{\alpha}\left[\sum_{j=1}^{m} h(q_j) - [h(1) + (m-1)h(0)]\sum_{j=1}^{m} q_j^{\alpha}\right]$$
$$- \sum_{j=1}^{m} q_j^{\beta}\sum_{i=1}^{n} h(p_i) + n(1-m)h(0) = 0 \tag{3.4}$$

for all $(p_1, \ldots, p_n) \in \Gamma_n$, $(q_1, \ldots, q_m) \in \Gamma_m$; $n \geq 3$, $m \geq 2$ being fixed integers. Now letting $p_1 = 1$, $p_2 = \cdots = p_n = 0$ in (3.4), we obtain equation

$$[h(1) + (m-1)h(0)]\sum_{j=1}^{m} q_j^{\alpha} - [h(1) + (n-1)h(0)]\sum_{j=1}^{m} q_j^{\beta}$$
$$+ (n-m)h(0) = 0. \tag{3.5}$$

Equation (3.5), indicates that the proof depends on the parameters α and β. So we divide our discussion into two cases.

Case 1: $\alpha = \beta$

In this case equation (3.5) reduces to $(n-m)h(0)\left[1-\sum_{j=1}^{m} q_j^{\beta}\right] = 0$. This implies either $(n-m)h(0) = 0$ or $1-\sum_{j=1}^{m} q_j^{\beta}$ vanishes identically on Γ_m. Suppose $1-\sum_{j=1}^{m} q_j^{\beta} = 0$ for all $(q_1,\ldots,q_m) \in \Gamma_m$. In particular for a probability distribution $\left(\frac{1}{2},\frac{1}{2},0,\ldots,0\right) \in \Gamma_m$, we have $\left(\frac{1}{2}\right)^{\beta} = \frac{1}{2}$ which holds only when $\beta = 1$. Since β is assumed to be a fixed positive real power with $\beta \neq 1$, we arrive at a contradiction and hence obtain $(n-m)h(0) = 0$.
Now considering $\alpha = \beta$, equation (3.4) reduces to

$$\sum_{i=1}^{n}\left\{\sum_{j=1}^{m} h(p_iq_j) - p_i^{\beta}\left[\sum_{j=1}^{m} h(q_j) - [h(1)+(m-1)h(0)]\sum_{j=1}^{m} q_j^{\beta}\right] - \sum_{j=1}^{m} q_j^{\beta} h(p_i)\right\} = n(m-1)h(0)$$

for all $(p_1,\ldots,p_n) \in \Gamma_n$, $(q_1,\ldots,q_m) \in \Gamma_m$; $n \geq 3$, $m \geq 2$ being fixed integers. By Result 2.1, there exists a mapping $\bar{A} : \mathbb{R}\times\Gamma_m \to \mathbb{R}$, additive in the first variable such that

$$\sum_{j=1}^{m} h(pq_j) - p^{\beta}\left[\sum_{j=1}^{m} h(q_j) - [h(1)+(m-1)h(0)]\sum_{j=1}^{m} q_j^{\beta}\right] - h(p)\sum_{j=1}^{m} q_j^{\beta} = \overline{A}(p;q_1,\ldots,q_m) - \frac{1}{n}\overline{A}(1;q_1,\ldots,q_m) + (m-1)h(0) \tag{3.6}$$

for all $p \in I$ and $(q_1,\ldots,q_m) \in \Gamma_m$. The substitution $p = 0$ in (3.6) gives $\overline{A}(1;q_1,\ldots,q_m) = -nh(0)\left[1-\sum_{j=1}^{m} q_j^{\beta}\right]$. Consequently, (3.6) becomes

$$\sum_{j=1}^{m} h(pq_j) - p^{\beta}\left[\sum_{j=1}^{m} h(q_j) - [h(1)+(m-1)h(0)]\sum_{j=1}^{m} q_j^{\beta}\right] - (h(p)-h(0))\sum_{j=1}^{m} q_j^{\beta} - mh(0) = \overline{A}(p;q_1,\ldots,q_m). \tag{3.7}$$

Let $x \in I$ and $(r_1,\ldots,r_m) \in \Gamma_m$. Now replacing p by xr_t, $t = 1,\ldots,m$ consecutively in (3.7); summing up the outcoming m equations so obtained

$$\sum_{t=1}^{m}\sum_{j=1}^{m} h(xr_tq_j) - x^{\beta}\sum_{t=1}^{m} r_t^{\beta}\left[\sum_{j=1}^{m} h(q_j) - [h(1)+(m-1)h(0)]\sum_{j=1}^{m} q_j^{\beta}\right] - \sum_{t=1}^{m} h(xr_t)\sum_{j=1}^{m} q_j^{\beta} + mh(0)\sum_{j=1}^{m} q_j^{\beta} - m^2h(0) = \overline{A}(x;q_1,\ldots,q_m) \tag{3.8}$$

for all $x \in I$, $(q_1, \ldots, q_m) \in \Gamma_m$ and $(r_1, \ldots, r_m) \in \Gamma_m$. Now put $p = x$ and $q_1 = r_1, \ldots, q_m = r_m$ in (3.7). We obtain

$$\sum_{t=1}^{m} h(xr_t) = x^\beta \left[\sum_{t=1}^{m} h(r_t) - [h(1) + (m-1)h(0)] \sum_{t=1}^{m} r_t^\beta\right] + (h(x) - h(0)) \sum_{t=1}^{m} r_t^\beta + mh(0) + \overline{A}(x; r_1, \ldots, r_m) \tag{3.9}$$

for all $x \in I$ and $(r_1, \ldots, r_m) \in \Gamma_m$. From equations (3.8) and (3.9), we get

$$\sum_{t=1}^{m}\sum_{j=1}^{m} h(xr_tq_j) - x^\beta \left(\sum_{t=1}^{m} r_t^\beta \sum_{j=1}^{m} h(q_j) + \sum_{j=1}^{m} q_j^\beta \sum_{t=1}^{m} h(r_t)\right) + \left(2x^\beta[h(1) + (m-1)\,h(0)] - h(x) + h(0)\right) \sum_{t=1}^{m} r_t^\beta \sum_{j=1}^{m} q_j^\beta - m^2 h(0) = \overline{A}(x; q_1, \ldots, q_m) + \overline{A}(x; r_1, \ldots, r_m) \sum_{j=1}^{m} q_j^\beta$$

for all $x \in I$, $(q_1, \ldots, q_m) \in \Gamma_m$ and $(r_1, \ldots, r_m) \in \Gamma_m$. Apparently, the left hand side of the above equation is symmetric in r_t and q_j, $t = 1, \ldots, m$; $j = 1, \ldots, m$ (Aczél [1]), so should be its right hand side. Hence we get

$$\overline{A}(x; q_1, \ldots, q_m) \left[1 - \sum_{t=1}^{m} r_t^\beta\right] = \overline{A}(x; r_1, \ldots, r_m) \left[1 - \sum_{j=1}^{m} q_j^\beta\right]. \tag{3.10}$$

As explained earlier that for fixed positive real power $\beta \neq 1$, $1 - \sum_{j=1}^{m} q_j^\beta$ does not vanish identically on Γ_m. Thus, there exists a probability distribution $(q_1^*, \ldots, q_m^*) \in \Gamma_m$ such that $1 - \sum_{j=1}^{m} q_j^{*\beta} \neq 0$. Making use of this in (3.10), we get

$$\overline{A}(x; r_1, \ldots, r_m) = a_2(x) \left[1 - \sum_{t=1}^{m} r_t^\beta\right] \tag{3.11}$$

where $a_2 : R \to R$ defined as $a_2(x) = \left[1 - \sum_{j=1}^{m} q_j^{*\beta}\right]^{-1} \overline{A}(x; q_1^*, \ldots, q_m^*)$ is an additive mapping with

$$a_2(1) = -nh(0). \tag{3.12}$$

Equations (3.7), (3.11), (3.12) with $(n-m)h(0) = 0$ yields the functional equation (C) where $H : I \to \mathbb{R}$ is defined as

$$H(x) = h(x) - a_2(x) - h(0) - [h(1) + (m-1)\,h(0)]x^\beta \tag{3.13}$$

for all $x \in I$. Clearly $H(0) = 0$ and $H(1) = 0$. Thus by Result 2.3, there exists a logarithmic mapping $\ell : I \to \mathbb{R}$ such that $H(p) = p^\beta \ell(p)$ for all $p \in I$. Hence by taking $\overline{c} := h(1) + (m-1)\,h(0)$, the solution (α_1) of (A) is attained with $(n-m)a_2(1) = 0$ from (3.13), (3.1) (with $\alpha = \beta$) and (3.2),

where the additive mapping $a_1 : \mathbb{R} \to \mathbb{R}$ is defined as $a_1(x) = a_2(x) + a(x)$ with $a_1(1) = -nmf(0)$.

Case 2: $\alpha \neq \beta$
In this case, let us put $q_1 = q$, $q_2 = 1 - q, q_3 = \cdots = q_m = 0$ in (3.5). We obtain

$$[h(1)+(m-1)h(0)][q^\alpha+(1-q)^\alpha] - [h(1)+(n-1)h(0)][q^\beta + (1-q)^\beta] + (n-m)h(0) = 0. \tag{3.14}$$

Now, let us put $q = \frac{1}{2}$ and $q = \frac{1}{4}$ respectively in (3.14). We obtain

$$\left[\frac{1}{2^{\alpha-1}} - \frac{1}{2^{\beta-1}}\right] h(1) + \left[\frac{(m-1)}{2^{\alpha-1}} - \frac{(n-1)}{2^{\beta-1}} + (n-m)\right] h(0) = 0, \tag{3.15}$$

$$\left[\frac{1}{4^\alpha} + \frac{3^\alpha}{4^\alpha} - \frac{1}{4^\beta} - \frac{3^\beta}{4^\beta}\right] h(1) + \left[\frac{(m-1)}{4^\alpha} + \frac{(m-1)3^\alpha}{4^\alpha} - \frac{(n-1)}{4^\beta} - \frac{(n-1)3^\beta}{4^\beta} + (n-m)\right] h(0) = 0. \tag{3.16}$$

Since $\alpha \neq \beta$, so the coefficients of $h(1)$ and $h(0)$ in equations (3.15) and (3.16) are nonzero real numbers. Therefore from (3.15) and (3.16), we have

$$(n-m)h(0)\left[\frac{1}{4^\alpha 2^{\beta-1}} + \frac{3^\alpha}{4^\alpha 2^{\beta-1}} - \frac{1}{4^\beta 2^{\alpha-1}} - \frac{3^\beta}{4^\beta 2^{\alpha-1}} + \frac{1}{2^{\alpha-1}} - \frac{1}{2^{\beta-1}} - \frac{1}{4^\alpha} - \frac{3^\alpha}{4^\alpha} + \frac{1}{4^\beta} + \frac{3^\beta}{4^\beta}\right] = 0.$$

From the above equation, it can be easily observed that either $(n-m)h(0) = 0$ or $\left[\frac{1}{4^\alpha 2^{\beta-1}} + \frac{3^\alpha}{4^\alpha 2^{\beta-1}} - \frac{1}{4^\beta 2^{\alpha-1}} - \frac{3^\beta}{4^\beta 2^{\alpha-1}} + \frac{1}{2^{\alpha-1}} - \frac{1}{2^{\beta-1}} - \frac{1}{4^\alpha} - \frac{3^\alpha}{4^\alpha} + \frac{1}{4^\beta} + \frac{3^\beta}{4^\beta}\right] = 0$. Suppose $\left[\frac{1}{4^\alpha 2^{\beta-1}} + \frac{3^\alpha}{4^\alpha 2^{\beta-1}} - \frac{1}{4^\beta 2^{\alpha-1}} - \frac{3^\beta}{4^\beta 2^{\alpha-1}} + \frac{1}{2^{\alpha-1}} - \frac{1}{2^{\beta-1}} - \frac{1}{4^\alpha} - \frac{3^\alpha}{4^\alpha} + \frac{1}{4^\beta} + \frac{3^\beta}{4^\beta}\right] = 0$ for every pair of fixed positive real powers $\alpha \neq \beta$. In particular, if we take $\alpha = 2$ and $\beta = 4$, then we arrive at a contradiction. So

$$(n-m)h(0) = 0. \tag{3.17}$$

Consequently from (3.14), we obtain the equation

$$[h(1) + (m-1)h(0)][q^\alpha + (1-q)^\alpha - q^\beta - (1-q)^\beta] = 0. \tag{3.18}$$

This implies either $h(1)+(m-1)h(0) = 0$ or $[q^\alpha+(1-q)^\alpha-q^\beta-(1-q)^\beta] = 0$. Suppose $[q^\alpha + (1-q)^\alpha - q^\beta - (1-q)^\beta] = 0$ for all $q \in I$ and every pair of fixed positive real powers $\alpha \neq \beta$. In particular, for $q = \frac{1}{2}$, it follows that $\left(\frac{1}{2}\right)^\alpha = \left(\frac{1}{2}\right)^\beta$ which is true only if $\alpha = \beta$. As a result we get a contradiction, so $h(1) + (m-1)h(0) = 0$ follows. Then (3.4) reduces to

$$\sum_{i=1}^{n}\sum_{j=1}^{m} h(p_i q_j) - \sum_{i=1}^{n} p_i^\alpha \sum_{j=1}^{m} h(q_j) - \sum_{j=1}^{m} q_j^\beta \sum_{i=1}^{n} h(p_i) + n(1-m)h(0) = 0$$

for all $(p_1,\ldots,p_n)\in\Gamma_n$, $(q_1,\ldots,q_m)\in\Gamma_m$; $n\geq 3$, $m\geq 2$ being fixed integers. Making use of (3.17), the above equation can be written as

$$\sum_{i=1}^{n}\sum_{j=1}^{m}h(p_iq_j)+nh(0)\sum_{i=1}^{n}p_i\sum_{j=1}^{m}q_j-nmh(0)-\sum_{i=1}^{n}p_i^{\alpha}\Bigg[\sum_{j=1}^{m}h\left(q_j\right)+nh(0)$$
$$\times\sum_{j=1}^{m}q_j-mh(0)\Bigg]-\sum_{j=1}^{m}q_j^{\beta}\left[\sum_{i=1}^{n}h\left(p_i\right)+nh(0)\sum_{i=1}^{n}p_i-nh(0)\right]=0. \quad (3.19)$$

Now define a mapping $g:I\to\mathbb{R}$ as

$$g\left(x\right)=h\left(x\right)+nh(0)x-h(0) \quad (3.20)$$

for all $x\in I$. Clearly $g(0)=0$ and $g(1)=0$. Also from (3.19) and (3.20), we obtain functional equation (1.6) (with g in place of f). Hence by Result 2.2, there exists an additive mapping $\overline{a}:\mathbb{R}\to\mathbb{R}$ and $c\in\mathbb{R}$ such that for all $p\in I$, $g(p)=\overline{a}(p)+c(p^{\alpha}-p^{\beta})$ with $\overline{a}(1)=0$. Consequently, the solution (α_2) of functional equation (A) is attained with $(n-m)a_4(1)=0$ from (3.20), (3.1)(with $h(1)+(m-1)h(0)=0$) and (3.2), where the additive mappings $a_4:\mathbb{R}\to\mathbb{R}$ is defined as $a_4(x)=\overline{a}(x)-nh(0)x$ with $a_4(1)=-nh(0)$ and $a_3:\mathbb{R}\to\mathbb{R}$ is defined as $a_3(x)=a_4(x)+a(x)$ with $a_3(1)=-nmf(0)$. This completes the proof. □

Note. We observe that from (3.17) two cases arise, which are $m\neq n$ and $m=n$. Consider the first case $m\neq n$. In this case, from (3.17), we get $h(0)=0$. Consequently (3.18) gives $h(1)[q^{\alpha}+(1-q)^{\alpha}-q^{\beta}-(1-q)^{\beta}]=0$ for all $q\in I$. Proceeding as above, we can obtain $h(1)=0$. Using the fact that $h(1)=0$, $h(0)=0$, equation (3.4) reduces to

$$\sum_{i=1}^{n}\sum_{j=1}^{m}h(p_iq_j)-\sum_{i=1}^{n}p_i^{\alpha}\sum_{j=1}^{m}h(q_j)-\sum_{j=1}^{m}q_j^{\beta}\sum_{i=1}^{n}h(p_i)=0$$

for all $(p_1,\ldots,p_n)\in\Gamma_n$, $(q_1,\ldots,q_m)\in\Gamma_m$; $n\geq 3$, $m\geq 2$ being fixed integers. By Result 2.2, it follows that $h:I\to\mathbb{R}$ is of the form $h(p)=c(p^{\alpha}-p^{\beta})+a_4(p), a_4(1)=0$, where $a_4:\mathbb{R}\to\mathbb{R}$ is an additive mapping and c is an arbitrary real constant. Further, using this in (3.1) and (3.2)(with $h(1)=0$ and $h(0)=0$), it follows that $f:I\to\mathbb{R}$ is of the form $f(p)=c(p^{\alpha}-p^{\beta})+a_3(p), a_3(1)=-nmf(0)$, where $a_3:\mathbb{R}\to\mathbb{R}$ is an additive mapping defined as $a_3(x)=a_4(x)+a(x)$ and c is an arbitrary real constant. This solution is included in (α_2) of (A).

On the otherhand, if we consider the case $m=n$, then proceeding as in Case 2, the solution (α_2) of (A) follows.

4. The Stability Of The Functional Equation (A)

In this section we discuss the stability of functional equation (A). For this we consider a perturbation of (A) given by functional inequality (B) and our aim is to find that *How do the solutions of inequality (B) differ from the solutions of equation (A)?*

Indeed in the sense of Hyers and Rassias [7], if the difference between their solutions is only a bounded mapping, we would say functional equation (A) is stable. Following this we establish the stability of (A) and thus prove:

Theorem 4.1. *Let $n \geq 3$, $m \geq 3$ be fixed integers; α and β be fixed positive real powers different from 1 satisfying the conventions (1.5); ε be a nonnegative real constant and let $f : I \to \mathbb{R}$, $h : I \to \mathbb{R}$ be real valued mappings.*
(I) *Suppose $\alpha = \beta$ and the pair (f,h) satisfies (B). Then there exist a logarithmic mapping $\ell : I \to \mathbb{R}$, the additive mappings $a_1, a_2 : \mathbb{R} \to \mathbb{R}$, the bounded mappings $b_1, b_2 : \mathbb{R} \to \mathbb{R}$ and $\bar{c} \in \mathbb{R}$ such that*

$$\left.\begin{array}{ll} (i) & f(p) - f(0) = p^\beta \ell(p) + a_1(p) + 2\bar{c}p^\beta + b_1(p) \\ & \text{with} \\ & |b_1(p)| \leq 4e\big\{m|h(0)| + 36\big[36\varepsilon(m+1) + m(m+2)|h(0)|\big]\big\} + 18\varepsilon, \\ (ii) & h(p) - h(0) = p^\beta \ell(p) + a_2(p) + \bar{c}p^\beta + b_2(p) \\ & \text{with} \\ & |b_2(p)| \leq 4e\big\{m|h(0)| + 36\big[36\varepsilon(m+1) + m(m+2)|h(0)|\big]\big\}. \end{array}\right\} \quad (\beta_1)$$

(II) *Suppose $\alpha \neq \beta$ and the pair (f,h) satisfies (B). Then there exist the additive mappings $a_3, a_4 : \mathbb{R} \to \mathbb{R}$, the bounded mappings $b_3, b_4 : \mathbb{R} \to \mathbb{R}$ and $c, \bar{c} \in \mathbb{R}$ such that*

$$\left.\begin{array}{ll} (i) & f(p) - f(0) = c(p^\alpha - p^\beta) + a_3(p) + b_3(p) \\ & \text{with} \\ & |b_3(p)| \leq \frac{18\varepsilon\big[2+2^{1-\alpha}-2^{1-\beta}\big]+|m-n||h(0)|}{2^{1-\alpha}-2^{1-\beta}} + \bar{c},\ b_3(0) = 0, \\ (ii) & h(p) - h(0) = c(p^\alpha - p^\beta) + a_4(p) + b_4(p) \\ & \text{with} \\ & |b_4(p)| \leq \frac{36\varepsilon+|m-n||h(0)|}{2^{1-\alpha}-2^{1-\beta}},\ b_4(0) = 0. \end{array}\right\} \quad (\beta_2)$$

Proof. Let us put $q_1 = 1$, $q_2 = \ldots = q_m = 0$ in (B). We obtain

$$\Big|\sum_{i=1}^{n}\big[f(p_i) + (m-1)f(0) - [h(1) + (m-1)h(0)]p_i^\alpha - h(p_i)\big]\Big| \leq \varepsilon$$

for all $(p_1, \ldots, p_n) \in \Gamma_n$. By Result 2.4, there exists an additive mapping $A_1 : \mathbb{R} \to \mathbb{R}$ and a bounded mapping $B_1^* : \mathbb{R} \to \mathbb{R}$ with $|B_1^*(p)| \leq 18\varepsilon$ and $B_1^*(0) = 0$, such that for all $p \in I$

$$f(p) - [h(1) + (m-1)h(0)]p^\alpha - h(p) - f(0) + h(0) = A_1(p) + B_1^*(p).$$

From this, one can easily obtain the expression

$$f(p) = h(p) + A_1(p) + B_1(p) + [h(1) + (m-1)h(0)]p^\alpha \quad (4.1)$$

where $B_1 : \mathbb{R} \to \mathbb{R}$ is a bounded mapping defined as $B_1(x) = f(0) - h(0) + B_1^*(x)$. Using (4.1), inequality (B) can be written to the form

$$\Bigg|\sum_{i=1}^{n}\Bigg[\sum_{j=1}^{m}h(p_iq_j) + A_1(1)p_i + \sum_{j=1}^{m}B_1(p_iq_j) + [h(1) + (m-1)h(0)] \times p_i^\alpha \sum_{j=1}^{m}q_j^\alpha - p_i^\alpha \sum_{j=1}^{m}h(q_j) - h(p_i)\sum_{j=1}^{m}q_j^\beta\Bigg]\Bigg| \leq \varepsilon.$$

By Result 2.4, there exists a mapping $A_2 : \mathbb{R} \times \Gamma_m \to \mathbb{R}$, additive in the first variable and a mapping $B_2 : \mathbb{R} \times \Gamma_m \to \mathbb{R}$, bounded in the first variable by

18ε with $B_2(0;q_1,\ldots,q_m)=0$, such that

$$\sum_{j=1}^{m}h(pq_j)+A_1(1)p+\sum_{j=1}^{m}B_1(pq_j)+[h(1)+(m-1)h(0)]p^{\alpha}\sum_{j=1}^{m}q_j^{\alpha}$$
$$-p^{\alpha}\sum_{j=1}^{m}h(q_j)-(h(p)-h(0))\sum_{j=1}^{m}q_j^{\beta}-mh(0)-mB_1(0)$$
$$=A_2(p;q_1,\ldots,q_m)+B_2(p;q_1,\ldots,q_m) \tag{4.2}$$

for all $p\in I$, $(q_1,\ldots,q_m)\in\Gamma_m$. Let $x\in I$ and $(r_1,\ldots,r_m)\in\Gamma_m$. Replacing p by xr_t, $t=1,\ldots,m$ consecutively in (4.2) and summing the resulting m equations so obtained, we have

$$\sum_{t=1}^{m}\sum_{j=1}^{m}h(xr_tq_j)+A_1(1)x+\sum_{t=1}^{m}\sum_{j=1}^{m}B_1(xr_tq_j)+x^{\alpha}[h(1)+(m-1)h(0)]$$
$$\times\sum_{t=1}^{m}r_t^{\alpha}\sum_{j=1}^{m}q_j^{\alpha}-x^{\alpha}\sum_{t=1}^{m}r_t^{\alpha}\sum_{j=1}^{m}h(q_j)-\sum_{t=1}^{m}h(xr_t)\sum_{j=1}^{m}q_j^{\beta}+mh(0)\sum_{j=1}^{m}q_j^{\beta}$$
$$-m^2h(0)-m^2B_1(0)=A_2(x;q_1,\ldots,q_m)+\sum_{t=1}^{m}B_2(xr_t;q_1,\ldots,q_m). \tag{4.3}$$

Now for $p=x$ and $q_j=r_t$, $j=1,\ldots,m$; $t=1,\ldots,m$; the functional equation (4.2) gives

$$\sum_{t=1}^{m}h(xr_t)=A_2(x;r_1,\ldots,r_m)+B_2(x;r_1,\ldots,r_m)-A_1(1)x-\sum_{t=1}^{m}B_1(xr_t)$$
$$-x^{\alpha}[h(1)+(m-1)h(0)]\sum_{t=1}^{m}r_t^{\alpha}+x^{\alpha}\sum_{t=1}^{m}h(r_t)+(h(x)-h(0))\sum_{t=1}^{m}r_t^{\beta}$$
$$+mh(0)+mB_1(0).$$

From the above equation, the functional equation (4.3) can be written as

$$\sum_{t=1}^{m}\sum_{j=1}^{m}h(xr_tq_j)+A_1(1)x+\sum_{t=1}^{m}\sum_{j=1}^{m}B_1(xr_tq_j)+x^{\alpha}[h(1)+(m-1)h(0)]$$
$$\times\sum_{t=1}^{m}r_t^{\alpha}\sum_{j=1}^{m}q_j^{\alpha}-(h(x)-h(0))\sum_{t=1}^{m}r_t^{\beta}\sum_{j=1}^{m}q_j^{\beta}-m^2h(0)-m^2B_1(0)$$
$$=x^{\alpha}\left[\sum_{t=1}^{m}r_t^{\alpha}\sum_{j=1}^{m}h(q_j)+\sum_{j=1}^{m}q_j^{\beta}\sum_{t=1}^{m}h(r_t)\right]+\left[A_2(x;r_1,\ldots,r_m)\right.$$
$$\left.+B_2(x;r_1,\ldots,r_m)-A_1(1)x-\sum_{t=1}^{m}B_1(xr_t)+mB_1(0)\right]\sum_{j=1}^{m}q_j^{\beta}$$
$$-x^{\alpha}[h(1)+(m-1)h(0)]\sum_{t=1}^{m}r_t^{\alpha}\sum_{j=1}^{m}q_j^{\beta}+A_2(x;q_1,\ldots,q_m)$$
$$+\sum_{t=1}^{m}B_2(xr_t;q_1,\ldots,q_m)$$

for all $x \in I$, $(q_1, \ldots, q_m) \in \Gamma_m$ and $(r_1, \ldots, r_m) \in \Gamma_m$. The symmetry of the terms in r_t and q_j, $t = 1, \ldots, m$; $j = 1, \ldots, m$ on the left hand side implies the symmetry on the right hand side. As a consequence we get

$$
\begin{aligned}
&A_2(x; q_1, \ldots, q_m) \left[1 - \sum_{t=1}^{m} r_t^{\beta}\right] - A_2(x; r_1, \ldots, r_m) \left[1 - \sum_{j=1}^{m} q_j^{\beta}\right] \\
&= \sum_{j=1}^{m} B_2(xq_j; r_1, \ldots, r_m) - \sum_{t=1}^{m} B_2(xr_t; q_1, \ldots, q_m) \\
&+ \left[B_2(x; q_1, \ldots, q_m) - \sum_{j=1}^{m} B_1(xq_j) + mB_1(0) - A_1(1)x\right] \sum_{t=1}^{m} r_t^{\beta} \\
&- \left[B_2(x; r_1, \ldots, r_m) - \sum_{t=1}^{m} B_1(xr_t) + mB_1(0) - A_1(1)x\right] \sum_{j=1}^{m} q_j^{\beta} \\
&- x^{\alpha}[h(1) + (m-1)h(0)] \left[\sum_{j=1}^{m} q_j^{\alpha} \sum_{t=1}^{m} r_t^{\beta} - \sum_{t=1}^{m} r_t^{\alpha} \sum_{j=1}^{m} q_j^{\beta}\right] \\
&+ x^{\alpha} \sum_{t=1}^{m} h(r_t) \left(\sum_{j=1}^{m} q_j^{\alpha} - \sum_{j=1}^{m} q_j^{\beta}\right) - x^{\alpha} \sum_{j=1}^{m} h(q_j) \left(\sum_{t=1}^{m} r_t^{\alpha} - \sum_{t=1}^{m} r_t^{\beta}\right). \qquad (4.4)
\end{aligned}
$$

Here, we notice that the equation (4.4), strongly depends on the parameters α and β. Therefore, we divide our discussion into two cases.

Case 1: $\alpha = \beta$
In this case, equation (4.4) results in the following equation

$$
\begin{aligned}
&A_2(x; q_1, \ldots, q_m) \left[1 - \sum_{t=1}^{m} r_t^{\beta}\right] - A_2(x; r_1, \ldots, r_m) \left[1 - \sum_{j=1}^{m} q_j^{\beta}\right] \\
&= \sum_{j=1}^{m} B_2(xq_j; r_1, \ldots, r_m) - \sum_{t=1}^{m} B_2(xr_t; q_1, \ldots, q_m) \\
&+ \left[B_2(x; q_1, \ldots, q_m) - \sum_{j=1}^{m} B_1(xq_j) + mB_1(0) - A_1(1)x\right] \sum_{t=1}^{m} r_t^{\beta} \\
&- \left[B_2(x; r_1, \ldots, r_m) - \sum_{t=1}^{m} B_1(xr_t) + mB_1(0) - A_1(1)x\right] \sum_{j=1}^{m} q_j^{\beta}. \qquad (4.5)
\end{aligned}
$$

For fixed $(q_1, \ldots, q_m) \in \Gamma_m$ and $(r_1, \ldots, r_m) \in \Gamma_m$, the right hand side of (4.5) is bounded on I while the left hand side is additive in $x \in I$, consequently by applying Result 2.5, it follows that

$$
[A_2(x; q_1, \ldots, q_m) - xA_2(1; q_1, \ldots, q_m)] \left[1 - \sum_{t=1}^{m} r_t^{\beta}\right]
$$

$$= [A_2(x; r_1, \ldots, r_m) - xA_2(1; r_1, \ldots, r_m)] \left[1 - \sum_{j=1}^{m} q_j^{\beta}\right]. \tag{4.6}$$

As explained in the previous section 3 that for fixed positive real power $\beta \neq 1$, $1 - \sum_{t=1}^{m} r_t^{\beta}$ does not vanish identically on Γ_m. Hence, there exists a probability distribution $(r_1^*, \ldots, r_m^*) \in \Gamma_m$ such that $1 - \sum_{t=1}^{m} r_t^{*\beta} \neq 0$. Equation (4.6) along with this fact results in

$$A_2(x; q_1, \ldots, q_m) = a_2(x) \left[1 - \sum_{j=1}^{m} q_j^{\beta}\right] + x\ A_2(1; q_1, \ldots, q_m) \tag{4.7}$$

where $a_2 : \mathbb{R} \to \mathbb{R}$ is a mapping defined as

$$a_2(x) = \left[1 - \sum_{t=1}^{m} r_t^{*\beta}\right]^{-1} [A_2(x; r_1^*, \ldots, r_m^*) - x\ A_2(1; r_1^*, \ldots, r_m^*)].$$

Clearly the mapping $a_2 : \mathbb{R} \to \mathbb{R}$ is an additive mapping with $a_2(1) = 0$. Using $\alpha = \beta$ and $1^{\beta} := 1$ in (4.2), we have

$$\begin{aligned} A_2\left(1; q_1, \ldots, q_m\right) = A_1(1) + \sum_{j=1}^{m} B_1(q_j) + mh(0) \sum_{j=1}^{m} q_j^{\beta} \\ - mh(0) - mB_1(0) - B_2\left(1; q_1, \ldots, q_m\right). \end{aligned} \tag{4.8}$$

With the help of (4.2), (4.7), (4.8), $a_2(1) = 0$ and $\alpha = \beta$, we gather that

$$\begin{aligned} &\sum_{j=1}^{m} H(pq_j) - p^{\beta} \sum_{j=1}^{m} H(q_j) - \sum_{j=1}^{m} q_j^{\beta} H(p) = p^{\beta} mh(0) \\ &+ p\left[\sum_{j=1}^{m} B_1(q_j) + mh(0) \sum_{j=1}^{m} q_j^{\beta} - mh(0) - mB_1(0) - B_2(1; q_1, \ldots, q_m)\right] \\ &+ B_2\left(p; q_1, \ldots, q_m\right) - \sum_{j=1}^{m} B_1(pq_j) + mB_1(0) \end{aligned} \tag{4.9}$$

where $H : I \to \mathbb{R}$ is a mapping defined as

$$H(x) = h(x) - a_2(x) - [h(1) + (m-1)\, h(0)]x^{\beta} - h(0) \tag{4.10}$$

for all $x \in I$. It follows from the definition of H given by (4.10) that $H(0) = 0$. Apparently, the right hand side of (4.9) is bounded by $36\varepsilon(m+1) + m(m+2)|h(0)|$, consequently by applying Result 2.4, and using $H(0) = 0$, there exists a mapping $A_3 : I \times \mathbb{R} \to \mathbb{R}$, additive in the second variable and a mapping $B_3 : I \times \mathbb{R} \to \mathbb{R}$, bounded in the second variable by $18\big[36\varepsilon(m+1) + m(m+2)|h(0)|\big]$ with $B_3(p, 0) = 0$, such that

$$H(pq) - p^{\beta} H(q) - q^{\beta} H(p) = A_3(p, q) + B_3(p, q)\,. \tag{4.11}$$

Define a mapping $G : I \times I \to \mathbb{R}$ as

$$G(p, q) = H(pq) - p^{\beta} H(q) - q^{\beta} H(p) \tag{4.12}$$

for all $p \in I$, $q \in I$. With the help of (4.12), it can easily be verified that

$$H(pqr) - p^{\beta}q^{\beta}H(r) - q^{\beta}r^{\beta}H(p) - r^{\beta}p^{\beta}H(q) = G(pq, r) + r^{\beta}G(p, q) \\ = G(p, qr) + p^{\beta}G(q, r) \tag{4.13}$$

for all $p \in I$, $q \in I$ and $r \in I$. From (4.11), (4.12) and (4.13), it follows that

$$A_3(p, qr) + p^{\beta}A_3(q, r) - A_3(pq, r) \\ = B_3(pq, r) + r^{\beta}A_3(p, q) + r^{\beta}B_3(p, q) - B_3(p, qr) - p^{\beta}B_3(q, r). \tag{4.14}$$

The left hand side of (4.14) is additive in $r \in I$, while its right hand side is bounded on I. Consequently by applying Result 2.5, it follows that left hand side is linear, i.e.

$$A_3(p, qr) + p^{\beta}A_3(q, r) - A_3(pq, r) = r\left[A_3(p, q) + p^{\beta}A_3(q, 1) - A_3(pq, 1)\right]. \tag{4.15}$$

Now, substituting $r = 1$ in (4.14), we get

$$p^{\beta}A_3(q, 1) - A_3(pq, 1) = B_3(pq, 1) - p^{\beta}B_3(q, 1). \tag{4.16}$$

From (4.14), (4.15) and (4.16), we obtain

$$\left(r - r^{\beta}\right)A_3(p, q) = B_3(pq, r) + r^{\beta}B_3(p, q) - B_3(p, qr) \\ - p^{\beta}B_3(q, r) - rB_3(pq, 1) + rp^{\beta}B_3(q, 1) \tag{4.17}$$

for all $p \in I$, $q \in I$ and $r \in I$. Since β is presumed to be a fixed positive real power with $\beta \neq 1$, equation (4.17) yield that the mapping $A_3(p, q)$ is bounded in q on I. Hence by Result 2.5, $A_3(p, q)$ must be linear. Therefore

$$A_3(p, q) = qA_3(p, 1) \tag{4.18}$$

for all $p \in I$, $q \in I$. Also equation (4.16) with the substitution $q = 1$ results in the following

$$A_3(p, 1) = p^{\beta}A_3(1, 1) - B_3(p, 1) + p^{\beta}B_3(1, 1) \tag{4.19}$$

for all $p \in I$. Consequently from (4.18) and (4.19), we conclude that the mapping $A_3(p, q)$ is bounded. Moreover we obtain its bound '$m|h(0)| + 18\big[36\varepsilon(m+1) + m(m+2)|h(0)|\big]$' as $A_3(p, 1) = -p^{\beta}H(1) - B_3(p, 1)$ (from (4.11) and (4.19)) and $|H(1)| \leq m|h(0)|$ (from (4.10)). Hence, the mapping G is also bounded and therefore by Result 2.6, on (4.11) we get $H(p) = p^{\beta}\ell(p) + b_2(p)$, where $\ell : I \to \mathbb{R}$ is a logarithmic mapping and $b_2 : \mathbb{R} \to \mathbb{R}$ is a bounded mapping with $|b_2(p)| \leq 4e\big\{m|h(0)| + 36\big[36\varepsilon(m+1) + m(m+2)|h(0)|\big]\big\}$. On taking $\bar{c} := h(1) + (m-1)h(0)$, the solution (β_1) of inequality (B) follows from (4.10) and (4.1) (with $\alpha = \beta$) by defining additive mapping $a_1 : \mathbb{R} \to \mathbb{R}$ as $a_1(x) = a_2(x) + A_1(x)$; a bounded mapping $b_1 : \mathbb{R} \to \mathbb{R}$ as $b_1(x) = b_2(x) + B_1^*(x)$ with $|b_1(x)| \leq 4e\big\{m|h(0)| + 36\big[36\varepsilon(m+1) + m(m+2)|h(0)|\big]\big\} + 18\varepsilon$.

Case 2: $\alpha \neq \beta$

In this case without any loss of generality, we may assume that $n \geq m$. So,

letting $p_{m+1} = \cdots = p_n = 0$ in (B) and using (4.1). We get

$$\left| \sum_{i=1}^{m}\sum_{j=1}^{m} h(p_i q_j) - \sum_{i=1}^{m} p_i^{\alpha} \sum_{j=1}^{m} h(q_j) - \sum_{j=1}^{m} q_j^{\beta} \sum_{i=1}^{m} h(p_i) \right.$$
$$+ [h(1) + (m-1)h(0)] \sum_{i=1}^{m} p_i^{\alpha} \sum_{j=1}^{m} q_j^{\alpha} + A_1(1) + \sum_{i=1}^{m}\sum_{j=1}^{m} B_1(p_i q_j)$$
$$\left. + m(n-m)h(0) - (n-m)h(0) \sum_{j=1}^{m} q_j^{\beta} + m(n-m)B_1(0) \right| \leq \varepsilon \qquad (4.20)$$

for all $(p_1, \ldots, p_m) \in \Gamma_m$, $(q_1, \ldots, q_m) \in \Gamma_m$. Now on interchanging the places of p_i and q_j, $i = 1, \ldots, m$; $j = 1, \ldots, m$ in the functional inequality (4.20), we have

$$\left| \sum_{i=1}^{m}\sum_{j=1}^{m} h(p_i q_j) - \sum_{j=1}^{m} q_j^{\alpha} \sum_{i=1}^{m} h(p_i) - \sum_{i=1}^{m} p_i^{\beta} \sum_{j=1}^{m} h(q_j) \right.$$
$$+ [h(1) + (m-1)h(0)] \sum_{i=1}^{m} p_i^{\alpha} \sum_{j=1}^{m} q_j^{\alpha} + A_1(1) + \sum_{i=1}^{m}\sum_{j=1}^{m} B_1(p_i q_j)$$
$$\left. + m(n-m)h(0) - (n-m)h(0) \sum_{i=1}^{m} p_i^{\beta} + m(n-m)B_1(0) \right| \leq \varepsilon. \qquad (4.21)$$

Applying triangle inequality to functional inequalities (4.20) and (4.21), we obtain

$$\left| \left[\sum_{j=1}^{m} q_j^{\alpha} - \sum_{j=1}^{m} q_j^{\beta} \right] \sum_{i=1}^{m} h(p_i) - \left[\sum_{i=1}^{m} p_i^{\alpha} - \sum_{i=1}^{m} p_i^{\beta} \right] \sum_{j=1}^{m} h(q_j) \right.$$
$$\left. + (n-m)h(0) \left[\sum_{i=1}^{m} p_i^{\beta} - \sum_{j=1}^{m} q_j^{\beta} \right] \right| \leq 2\varepsilon\,. \qquad (4.22)$$

Before proceeding further we assert that $\sum_{j=1}^{m} q_j^{\alpha} - \sum_{j=1}^{m} q_j^{\beta} \not\equiv 0$ on Γ_m. To the contrary suppose, $\sum_{j=1}^{m} q_j^{\alpha} - \sum_{j=1}^{m} q_j^{\beta} = 0$ for all $(q_1, \ldots, q_m) \in \Gamma_m$. In particular for a probability distribution $\left(\frac{1}{m}, \frac{1}{m}, \ldots, \frac{1}{m}\right) \in \Gamma_m$, we obtain $\left(\frac{1}{m}\right)^{\alpha} = \left(\frac{1}{m}\right)^{\beta}$ which is true only if $\alpha = \beta$. However, as per our assumption $\alpha \neq \beta$, we arrive at a contradiction and so our assertion follows. Consequently, there always exists a probability distribution $(q_1^*, \ldots, q_m^*) \in \Gamma_m$ for which $0 \neq \sum_{j=1}^{m} q_j^{*\alpha} - \sum_{j=1}^{m} q_j^{*\beta}$ on Γ_m. Further, in order to obtain a particular bound for the bounded mapping in the subsequent part of the proof we make use of this assertion by choosing $(q_1, \ldots, q_m) = \left(\frac{1}{2}, \frac{1}{2}, 0, \ldots, 0\right) \in \Gamma_m$ in functional inequality (4.22) and obtain

$$\left|\left[2^{1-\alpha}-2^{1-\beta}\right]\sum_{i=1}^{m}h\left(p_i\right)-\left[2h\left(\frac{1}{2}\right)+(m-2)h(0)\right]\sum_{i=1}^{m}p_i^{\alpha}\right.$$
$$\left.+\left[2h\left(\frac{1}{2}\right)+(n-2)h(0)\right]\sum_{i=1}^{m}p_i^{\beta}-(n-m)\,h(0)2^{1-\beta}\right|\leq 2\varepsilon \tag{4.23}$$

for all $(p_1,\ldots,p_m)\in\Gamma_m$. Since for $\alpha\neq\beta$, $2^{1-\alpha}-2^{1-\beta}\neq 0$, the above inequality can written as

$$\left|\sum_{i=1}^{m}\left[h\left(p_i\right)-c_1p_i^{\alpha}+c_2p_i^{\beta}-c_3p_i\right]\right|\leq\frac{2\varepsilon}{2^{1-\alpha}-2^{1-\beta}} \tag{4.24}$$

where $c_1:=\frac{2h\left(\frac{1}{2}\right)+(m-2)h(0)}{2^{1-\alpha}-2^{1-\beta}}\in\mathbb{R}$; $c_2:=\frac{2h\left(\frac{1}{2}\right)+(n-2)h(0)}{2^{1-\alpha}-2^{1-\beta}}\in\mathbb{R}$; $c_3:=\frac{(n-m)h(0)2^{1-\beta}}{2^{1-\alpha}-2^{1-\beta}}\in\mathbb{R}$ and $(p_1,\ldots,p_m)\in\Gamma_m$. By Result 2.4, there exists an additive mapping $A_4:\mathbb{R}\to\mathbb{R}$ and a bounded mapping $B_4:\mathbb{R}\to\mathbb{R}$ where $|B_4(p)|\leq\frac{36\varepsilon}{2^{1-\alpha}-2^{1-\beta}}$ with $B_4(0)=0$, such that

$$h(p)-c_1p^{\alpha}+c_2p^{\beta}-c_3p-h(0)=A_4(p)+B_4(p)$$

for all $p\in I$. Thus, on taking $c:=c_1$ we obtain $(\beta_2)(ii)$ by defining additive mapping $a_4:\mathbb{R}\to\mathbb{R}$ as $a_4(x)=A_4(x)+c_3x$ and bounded mapping $b_4:\mathbb{R}\to\mathbb{R}$ as $b_4(x)=B_4(x)+\frac{(m-n)h(0)}{2^{1-\alpha}-2^{1-\beta}}x^{\beta}$ where $b_4(0)=0$ and $|b_4(x)|\leq\frac{36\varepsilon+|m-n||h(0)|}{2^{1-\alpha}-2^{1-\beta}}$. Further for $\bar{c}:=h(1)+(m-1)h(0)$, we obtain $(\beta_2)(i)$ from (4.1) by defining additive mapping $a_3:\mathbb{R}\to\mathbb{R}$ as $a_3(x)=a_4(x)+A_1(x)$ and bounded mapping $b_3:\mathbb{R}\to\mathbb{R}$ as $b_3(x)=b_4(x)+B_1^*(x)+\bar{c}x^{\alpha}$ where $b_3(0)=0$ and $|b_3(x)|\leq\frac{18\varepsilon\left[2+2^{1-\alpha}-2^{1-\beta}\right]+|m-n||h(0)|}{2^{1-\alpha}-2^{1-\beta}}+\bar{c}$. □

5. Comments

The objective of this section is to discuss the significance of solutions (α_1) and (α_2) of (A) from the perspective of information theory.

The entropies $H_n^{\beta}:\Gamma_n\to\mathbb{R}$, $n=1,2,\ldots$ of degree β $(0<\beta\in\mathbb{R},\beta\neq 1)$ are defined as:

$$H_n^{\beta}(p_1,\ldots,p_n)=(1-2^{1-\beta})^{-1}\left[1-\sum_{i=1}^{n}p_i^{\beta}\right] \tag{5.1}$$

for all $(p_1,\ldots,p_n)\in\Gamma_n$. The nonadditive entropies of degree β given by (5.1) were introduced by Havrda and Charvát [6].

Keeping in mind the form of entropies of type (α,β) for $\alpha=\beta$ given by (1.4), it is desirable to consider the logarithmic mapping $\ell:I\to\mathbb{R}$ as

$$\ell(p)=\begin{cases}\lambda\log_2 p & \text{if } p\in\,]0,1]\\ 0 & \text{if } p=0\end{cases} \tag{5.2}$$

where λ is an arbitrary real constant. With the help of (1.4) and (5.2), the solution (α_1) gives

$$\sum_{i=1}^{n}f(p_i)=2\bar{c}[1+(2^{1-\beta}-1)H_n^{\beta}(p_1,\ldots,p_n)]$$

$$- \lambda 2^{1-\beta} H_n^{(\beta,\beta)}(p_1, \ldots, p_n) + n(1-m)f(0)$$

and

$$\sum_{i=1}^{n} h(p_i) = \bar{c}[1 + (2^{1-\beta} - 1)H_n^{\beta}(p_1, \ldots, p_n)] - \lambda 2^{1-\beta} H_n^{(\beta,\beta)}(p_1, \ldots, p_n).$$

Thus it can be concluded that both the mappings f and h of the solution (α_1) are connected to entropies of type (α, β))(for $\alpha = \beta$) and entropies of degree β if $\lambda \neq 0$ and $\bar{c} \neq 0$. Also if $\lambda = 0$, $\bar{c} \neq 0$, then both the mappings f and h are connected to the entropies of degree β only. Moreover if $\lambda \neq 0$, $\bar{c} = 0$, then both the mappings f and h are connected to the entropies of type (α, β) (for $\alpha = \beta$) only. However if $\lambda = 0$, $\bar{c} = 0$, then the summands $\sum_{i=1}^{n} f(p_i)$ and $\sum_{i=1}^{n} h(p_i)$ do not represent any form of entropies, so this case is not of much importance.

Now, we compute the summands related to the solution (α_2) of (A) and using (1.4), we obtain

$$\sum_{i=1}^{n} f(p_i) = c(2^{1-\alpha} - 2^{1-\beta}) H_n^{(\alpha,\beta)}(p_1, \ldots, p_n) + n(1-m)f(0)$$

and

$$\sum_{i=1}^{n} h(p_i) = c(2^{1-\alpha} - 2^{1-\beta}) H_n^{(\alpha,\beta)}(p_1, \ldots, p_n)\,.$$

Thus it can be seen that if $c \neq 0$, then both the mappings f and h of the solution (α_2) are connected to entropies of type (α, β)(for $\alpha \neq \beta$) and if $c = 0$, then the summands $\sum_{i=1}^{n} f(p_i)$ and $\sum_{i=1}^{n} h(p_i)$ do not represent any form of entropies. Consequently the case $c = 0$ is not of much importance.

Summarizing this section we conclude that the functional equation (A) is emerging from information theory as it is related to entropies of type (α, β) and entropies of degree β.

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Research Article

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Improved cryptanalysis of a ElGamal Cryptosystem Based on Matrices Over Group Rings

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Abstract: ElGamal cryptosystem has emerged as one of the most important construction in Public Key Cryptography (PKC) since Diffie-Hellman key exchange protocol was proposed. However, public key schemes which are based on number theoretic problems such as discrete logarithm problem (DLP) are at risk because of the evolution of quantum computers. As a result, other non-number theoretic alternatives are a dire need of entire cryptographic community.
In 2016, Saba Inam and Rashid Ali proposed a ElGamal-like cryptosystem based on matrices over group rings in 'Neural Computing & Applications'. Using linear algebra approach, Jia et al. provided a cryptanalysis for the cryptosystem in 2019 and claimed that their attack could recover all the equivalent keys. However, this is not the case and we have improved their cryptanalysis approach and derived all equivalent key pairs that can be used to totally break the ElGamal-like cryptosystem proposed by Saba and Rashid. Using the decomposition of matrices over group rings to larger size matrices over rings, we have made the cryptanalysing algorithm more practical and efficient. We have also proved that the ElGamal cryptosystem proposed by Saba and Rashid does not achieve the security of IND-CPA and IND-CCA.

Keywords: Group ring decomposition; ElGamal cryptosystem; circulant matrices

2020 Mathematics Subject Classification: 94A60

1 Introduction

The security of ElGamal encryption scheme depends on the difficulty of solving the discrete logarithm problem. The standard security notion for ElGamal encryption scheme is indistinguishability under a chosen plaintext attack (IND-CPA) whereas a stronger notion of security is indistinguishability under a chosen ciphertext attack (IND-CCA).

Due to the inability of resisting quantum attacks, various traditional cryptosystem based on DLP are not considered secure and there has been interest in constructing ElGamal encryption scheme via non-number theoretic platform structures. In this context, Majid Khan et al. [6] proposed two new ElGamal public key encryption schemes based on the large commutative subgroups of general linear groups on the residual ring which was later cryptanalyzed by Jia et al. [4] using structural attack.

In 2016, Inam and Ali improved it [3] and proposed a new ElGamal-like cryptosystem based on matrices over group ring. The authors claimed that the cryptosystem is safe against known plaintext attacks and has the potential to resist quantum attacks. But using a linear algebra attack, this proposed cryptosystem was

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On the stability of a sum form functional equation related to entropies of type (α, β)

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Abstract

In this paper, we discuss the stability of the sum form functional equation

$$\sum_{i=1}^{n}\sum_{j=1}^{m} f(p_i q_j) = \sum_{i=1}^{n} g(p_i)\sum_{j=1}^{m} f(q_j) + \sum_{i=1}^{n} f(p_i)\sum_{j=1}^{m} q_j^{\beta}$$

for all complete probability distributions $(p_1,\ldots,p_n) \in \Gamma_n$, $(q_1,\ldots,q_m) \in \Gamma_m$, $n \geqslant 3$, $m \geqslant 3$ are fixed integers, f, g are real valued mappings each having the domain $I = [0,1]$ and β is a fixed positive real power such that $\beta \neq 1$, $0^{\beta} := 0$, $1^{\beta} := 1$.

Keywords: Stability, additive mapping, logarithmic mapping, multiplicative mapping, bounded mapping, entropies of type (α, β).

2020 MSC: 39B52, 39B82.

1. Introduction

Over the last few years, functional equations with reference to the stability problem has emerged as a new branch of research. Indeed, one of the stimulating aspect considered in this direction is to examine the stability of those functional equations whose general solutions exist and are useful in characterizing entropies. Captivated by the same here we have identified and discussed the stability of a Pexiderized functional equation which characterizes an entropy of type (α, β) and whose general solutions have been obtained.

Let $\mathbb{R}$ denotes the set of real numbers and I denotes the closed interval $[0,1]$. For $n = 1, 2, \ldots$, let

$$\Gamma_n = \left\{ (p_1,\ldots,p_n) : p_i \geqslant 0,\ i = 1,\ldots,n; \sum_{i=1}^{n} p_i = 1 \right\}$$

denote the set of all finite n-component discrete probability distributions.

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On the stability of a sum form functional equation related to nonadditive entropies

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Abstract

In this paper we intend to discuss the stability of

$$\sum_{i=1}^{n}\sum_{j=1}^{m} f(p_i q_j) = \sum_{i=1}^{n} M_1(p_i)\sum_{j=1}^{m} g(q_j) + \sum_{j=1}^{m} M_2(q_j)\sum_{i=1}^{n} h(p_i),$$

where $f : I \to \mathbb{R}$, $g : I \to \mathbb{R}$, $h : I \to \mathbb{R}$ are unknown mappings; $M_1 : I \to \mathbb{R}$, $M_2 : I \to \mathbb{R}$ are fixed multiplicative mappings both different from identity mapping; $(p_1, \ldots, p_n) \in \Gamma_n$, $(q_1, \ldots, q_m) \in \Gamma_m$; $n \geqslant 3$, $m \geqslant 3$ are fixed integers.

Keywords: Stability, bounded mapping, logarithmic mapping, multiplicative mapping.

2020 MSC: 39B52, 39B82.

1. Introduction

Let $\mathbb{N}$ denote the set of natural numbers; $\mathbb{R}$ denote the set of real numbers; I denote the closed unit interval $[0,1]$, i.e., $I = [0,1] = \{x \in \mathbb{R} : 0 \leqslant x \leqslant 1\}$. For $n \in \mathbb{N}$; let $\Gamma_n = \{(p_1, \ldots, p_n);\ p_i \geqslant 0,\ i = 1, \ldots, n;\ \sum_{i=1}^{n} p_i = 1\}$ denote the set of all n-component discrete probability distributions.

A mapping $a : I \to \mathbb{R}$ is said to be additive on I or on the unit triangle $\Delta = \{(x,y) : 0 \leqslant x \leqslant 1, 0 \leqslant y \leqslant 1, 0 \leqslant x+y \leqslant 1\}$ if it satisfies $a(x+y) = a(x) + a(y)$ for all $(x,y) \in \Delta$. Similarly, a mapping $A : \mathbb{R} \to \mathbb{R}$ is said to be additive on $\mathbb{R}$ if it satisfies $A(x+y) = A(x) + A(y)$ for all $x \in \mathbb{R}$, $y \in \mathbb{R}$. An interesting relation between these fore mentioned additive mappings was given by Daróczy and Losonczi [4]. They proved that there exists a unique additive extension of the additive mapping $a : I \to R$ to the set of real numbers.

A mapping $\ell : I \to \mathbb{R}$ is said to be logarithmic on I if it satisfies $\ell(0) = 0$ and $\ell(xy) = \ell(x) + \ell(y)$ for all $x \in]0,1]$, $y \in]0,1]$.

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ORIGINAL ARTICLE

The unpredictability of the basins of attraction in photogravitational Chermnykh's problem

Vinay Kumar[1] · Pankaj Sharma[1] · Rajiv Aggarwal[2] · Sushil Yadav[3] · Bhavneet Kaur[4]

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Abstract This paper deals with the photogravitational circular restricted three-body problem, including the effect of circular cluster of material points. The parametric evolution of the position of equilibrium points and the existence of a different number of equilibrium points are illustrated using graphs. A detailed investigation to find out the influence of the radiation pressure q, mass ratio μ and the circular cluster of material points M_b on the geometry of basins of attraction is carried out. Further, the number of iterations required to obtain the desired level of accuracy is recorded and presented using probability distribution diagram. The correlations between the domain of convergence of equilibrium points and the corresponding number of the iterations required to obtain the desired level of accuracy are explained. We monitor the parametric evolution of the basin entropy to reveal the unpredictability in the basins of attractions. It is found that unpredictable (fractal) regions exist in the vicinity of boundaries of the basins of attraction.

Keywords Basin of attraction · Basin entropy · Newton-Raphson method · Fractal · Chermnykh's problem

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1 Introduction

The study of the complex structure of the phase space of nonlinear models in the field of space dynamics and celestial mechanics has gained remarkable attention of those mathematicians who have been working in this field for decades. For a better understanding, several tools have been introduced in the past few years. The basin of attraction (or basin of convergence) is one of the important tools. Our observations took place while following many recent contributions in this field (e.g., Aguirre et al. (2009), Suraj et al. (2018), Zotos (2017), Zotos et al. (2020), Kalvouridis and Gousidou-Koutita (2012), Seoane and Sanjuán (2013), Sprott and Xiong (2015)). In the present work, we have utilised this tool to examine the geometry of the domain of convergence in a specific model.

The Chermnykh's problem is a new kind of restricted three-body problem which was first time studied by Chermnykh (1987). The Chermnykh-like problem has a number of applications in different areas such as celestial mechanics, chemistry, extrasolar planetary system (e.g., Goździewski and Maciejewski (1999), Strand and Reinhardta (1979), Rivera and Lissauer (2000), Jiang and Ip (2001)). The authors have investigated the Chermnykh's problem by including the effect from a circular cluster of material points for planetary systems and found the existence of libration points around the inner part of the circular cluster of material points (see Jiang and Yeh (2003, 2004a,b,c), Abouelmagd et al. (2014) and Kushvah and Kishor (2013)). It has been noticed that the circular cluster of material points has a considerable impact on the structure of the dynamical system (e.g., Jiang and Yeh (2003, 2006), Kushvah (2008), Singh and Taura (2014)). The primaries in a circular restricted three-body problem (CR3BP) are generally considered to be spherical, but in real situations, we ob-

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Elliptic Sitnikov five-body problem under radiation pressure

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ABSTRACT

We consider the square configuration of photo-gravitational elliptic restricted five-body problem and study the Sitnikov motions. The four radiating primaries are of equal mass placed at the vertices of square and the fifth body having negligible mass performs oscillations along a straight line perpendicular to the orbital plane of the primaries. The motion of the fifth body is called vertical periodic motion and the main aim of this paper is to study the effect of radiation pressure on these periodic motions in the linear approximation. Moreover, the effects of radiation pressure on the motion of fifth body have been examined with the help of Poincare surfaces of section. By escalating the radiation pressure, surrounding periodic tubes and islands disappear and chaotic motion occurs near the hyperbolic points. Further, by escalating the radiation pressure, the main stochastic region joins the escaping one.

1. Introduction

The study of oscillatory motions in the elliptic restricted three-body problem is termed as 'Sitnikov Problem'. The Sitnikov problem is a spatial case of restricted three-body in which a massless body oscillates along a straight line perpendicular to the orbital plane of the primaries having equal masses moving on symmetric Keplerian orbits. The equation of motion for the massless body depends only on time t and on one parameter, the eccentricity of the primaries e Sitnikov (1960). The Sitnikov problem is a general case of MacMillan problem (Millan, 1913) that is the integrable approximation of the Sitnikov problem for $e = 0$. For $e \neq 0$ the dynamical system is chaotic, despite its simple form, and allows all different kinds of motions that are found in chaotic dynamical systems. The simplicity of its mathematical formulation together with the complexity of its possible kinds of motions makes the Sitnikov problem a unique dynamical problem in the context of celestial mechanics.

In the past decades, Sitnikov problem is studied by many researchers. The exact solution of the Jacobi elliptic integral has been discussed in detail by Stumpff (1965). A new analytic approach to Sitnikov problem is discussed by Hagel (1992). Berdichevsky et al. (1994) have studied the averaged characteristics to the response of Duffing's oscillator to harmonic excitation. Jalali and Pourtakdoust (1997) have investigated the regular solution of the Sitnikov problem at the 3/2 commensurability, by using the rotating coordinate system and averaging method. Dvorak and Sun (1997) have explored the structure of phase space with the help of surfaces of section. Chasley (1999) has reduced the Sitnikov problem to two-dimensional area preserving Poincare section depending on two parameters, one is mass ratio and other is total angular momentum. Corbera and Llibre (2000) have proved the existence of symmetric periodic orbits of the elliptic Sitnikov problem using Poincare section and the presence of the Bernoulli shift. Faruque (2002) has calculated the motion of the planetoid by Lindstedt Poincare perturbation and Green function. Soulis et al. (2007) have worked on the stability of motion in the Sitnikov problem. Soulis et al. (2008) have discussed periodic orbits and bifurcations in the Sitnikov four-body problem. Bountis and Papakadis (2009) have studied stability of vertical motion in the circular Sitnikov N-body problem. Perdios and Markellos (2012) have done self-resonant bifurcations of the Sitnikov family and the appearance of 3-D isolas in the restricted three-body problem. Pandey and Ahmad (2013a), Pandey and Ahmad (2013b) have discussed periodic orbits, bifurcations and regions of motion in the Sitnikov four-body problem. Suraj and Hassan (2014) have discussed Sitnikov restricted four-body problem under the effect of radiation pressure. Ullah and Hassan (2014a,b) have compared averaged Hamiltonian, series solution and Poincare section in the Sitnikov three-body problem and four-body problem and they further generalized series solutions and stability in the Sitnikov N + 1-body problem. Ullah et al. (2014),Ullah et al. (2015)) have introduced the kite configuration in the Sitnikov problem, and

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Elliptic restricted synchronous three-body problem (ERS3BP) with a mass dipole model

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ABSTRACT

The goal of the present manuscript is to determine the points of libration and their linear stability in the elliptic restricted synchronous three-body problem with a mass dipole model. The dipole system consists of two-point masses connected with a massless rod in a constant characteristic distance. To execute this study, we acquire the equations of motion of a spacecraft having negligible mass travelling in the system in which more massive primary is assumed to have a spherical shape, and the lesser one is irregular shaped and considered as a rotating mass dipole. The locations of the libration points are analyzed for various values of e, where e is the eccentricity of the orbit of one massive primary around other. Also, the stability of the libration points is investigated in linear sense, and it is observed that the collinear libration points are unstable while the non-collinear libration points are stable for the critical mass parameter μ_c. Further, we investigated the regions of motion around libration points.

1. Introduction

The elliptic restricted three-body problem (ER3BP) is a generalized case of circular restricted three-body problem, describes the dynamics of the system more accurately as the primaries move along the elliptical orbits around their common center of mass. In recent decades, ER3BP has been studied by many mathematicians in different aspects. Danby (1964) studied the linear stability of the elliptical Lagrange orbit in elliptic restricted three-body problem. He has used numerical integration to determine the linear stability of the elliptical Lagrange orbit. He also obtained a stability diagram in the $\mu - e$ plane, where μ is the mass parameter and e is the eccentricity of the elliptic orbit of one primary around other. Bennett (1965) used Floquet theory to obtained characteristic roots and exponents for the libration points in the elliptical restricted three-body problem. ER3BP has been studied by Szebehely in 1967, taken into account only the gravitational forces, and found that there exist three collinear libration points and two non-collinear libration points. The collinear libration points are unstable but non-collinear libration points are stable for the critical mass parameter $0 < \mu < \mu_c$. Gyorgyey (1985) has studied the non-linear stability of triangular libration point L_5 in the elliptic restricted three-body problem. Kumar et.al. (1990) have extended the study of Gyorgyey (1985) taking into account the effect of solar radiation pressure on the non-linear stability of L_5 in the elliptic restricted three-body problem. Llibre et.al. (1990) have shown that the elliptic restricted three-body problem has ejection-collision orbits when the mass parameter μ is very small. Markellos et.al. (1992) examined the linear stability of the triangular libration points in the photogravitational elliptic restricted three-body problem, and stability regions are also determined by them. Zimovshchikov et.al. (2004) have studied the stability of collinear as well as non-collinear libration points, and resonance phenomena in the photogravitational elliptic restricted three-body problem. Kumar et.al. (2009) have studied the generalized photogravitational elliptic restricted three-body problem, considering both primaries as oblate spheroids. Singh et.al. (2012) have investigated the stability of triangular libration points $L_{4,5}$ in the elliptic restricted three-body problem, when both primaries are oblate as well as the source of radiations. Narayan et.al. (2014) have investigated the stability of triangular equilibrium points in the elliptic restricted problem of three bodies with radiating and triaxial primaries. Abouelmagd et al. (2015) have studied the periodic and secular solutions in the restricted three-body problem under the effect of zonal harmonic parameters. Alzahrani et al. (2017) have examined the stability of collinear libration points in the framework of Euler's angles. Idrisi et.al. (2018) have shown the albedo and oblateness effect on the existence and stability of non-collinear libration points in the elliptic restricted three-body problem. Idrisi et.al. (2020) have discussed the linearly stability of libration points in the elliptic restricted three-body problem taking into

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Unpredictable basin boundaries in restricted six-body problem with square configuration

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Fractal basin boundary
Wada basin

ABSTRACT

The present work deals with the recently introduced restricted six body-problem with square configuration. We have computed and verified the position of libration points with the help of Newton-Raphson method. It is observed that the total number of libration points are either twelve or twenty depends upon the mass parameter $\mu \in (0,\ 0.25)$. The multivariate form of Newton-Raphson scheme is used to discuss the basins of attraction. Different aspects of the basins of attraction are investigated and explained in detail. The complex combination of the different basins is found along the boundaries. The concept of basin entropy is used to unveil the nature of the boundaries. For $\mu \in (0.215,\ 0.238)$, the basins of attraction are unpredictable throughout. It is observed that for all values of the mass parameter μ, the basin boundaries are highly unpredictable. Moreover, we have investigated the presence of Wada basin boundary in the basin of attraction.

1. Introduction

In the field of *Celestial Mechanics*, the *N*-body problem has a very significant contribution. It has numerous applications in the field of galactic dynamics and motion of planetary objects. Many articles are available on the *N*-body problem for $N = 3, 4$ and 5 are by Michalodimitrakis (1981), Kalvouridis (1999), Celli (2007), Baltagiannis and Papadakis (2011), Shoaib and Faye (2011), Papadouris and Papadakis (2013), Arribas et al. (2016), Marchesin (2017), Alzahrani et al. (2017), Abouelmagd and Ansari (2013), Abouelmagd et al. (2013), Abouelmagd et al. (2015) and Abouelmagd et al. (2019). Recently, we have introduced a particular case of *N*-body problem known as restricted six-body problem with square configuration studied by Idrisi and Ullah (2020). Thus, a lot of work has to be done in this model. The restricted six-body problem is to study the motion of test particle under the gravitational fields of four primaries placed at the vertices of the square, while one primary is placed at the center of mass of the system. We have considered the mass ratio μ as the only parameter.

In general, for the *N*-body problem ($N > 4$), there is no specific method to determine the number of libration points. Therefore, we usually find it using numerical methods. Since, there are various numerical methods available to find out the libration points (or roots) of these dynamical systems. Among them, the N-R scheme is very well known and established method to determine the roots of nonlinear dynamical systems. In our case, we need the multivariate form of the N-R scheme. While going through recent articles on the applications of N-R method by Sprott and Xiong (2015) and Osorio-Vargas et al. (2020), we note that some initial conditions converge very quickly, some of them need more number of iterations, some of them even do not converge to any of the libration points. Thus, the study of the convergence of initial conditions is also a crucial aspect of the investigation. Also, it is essential to note that the initial conditions lying along the boundary need a higher number of iterations. Therefore, the detailed study of the BoA in R6BP is also one of the critical aspect.

The applications of the N-R scheme to the restricted problem of *N* bodies can be found in the work of Suraj et al. (2019a,b) and Zotos (2018). Based on that, we have investigated the BoA in R6BP using the multivariate form N-R scheme. In many cases, the BoA is found to be smooth except few. However, when the basins are not smooth, then we search for the degree of unpredictability in BoA and along boundaries of BoA. To measure this, we use the concept of basin entropy introduced recently by Daza et al. (2016). The configuration plane $(x,\ y)$ can be divided into two parts; one is fractal region and the other is non-fractal region (based on log 2 graph shown in Fig. 7). We can decide about the region based on the values of S_b and S_{bb}, obtained using algorithm. When there is a coexistence of two or more attractors, there is a possibility for the occurrence of an important property called Wada. The

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Covid-19: a comprehensive review of a formidable foe and the road ahead

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Abstract

Introduction: The Coronavirus disease-19 (COVID-19) caused by the novel beta coronavirus named severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) started in late December 2019 in

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The coordinated outcome of STIM1-Orai1 and superoxide signalling is crucial for headkidney macrophage apoptosis and clearance of *Mycobacterium fortuitum*

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ABSTRACT

The mechanisms underlying *M. fortuitum*-induced pathogenesis remains elusive. Using headkidney macrophages (HKM) from *Clarias gariepinus*, we report that TLR-2-mediated internalization of *M. fortuitum* is imperative to the induction of pathogenic effects. Inhibiting TLR-2 signalling alleviated HKM apoptosis, thereby favouring bacterial survival. Additionally, TLR-2-mediated cytosolic calcium $(Ca^{2+})_c$ elevation was instrumental for eliciting ER-stress in infected HKM. ER-stress triggered the activation of membrane-proximal calcium entry channels comprising stromal interaction molecule 1 (STIM1) and calcium-release activated calcium channel 1 (Orai1). RNAi studies suggested STIM1-Orai1 signalling initiate calpain-mediated cleavage of nitric oxide synthase interacting protein, prompting the release of pro-apoptotic nitric oxide. Inhibiting STIM1-Orai1 signalling attenuated superoxide production $(O_2^{\bullet-})$ and *vice versa.* We conclude, TLR-2-induced ER-stress triggers *STIM1/Orai1* expression and that the reciprocal association between STIM1-Orai1 signalling and oxidative stress is critical for sustaining $(Ca^{2+})_c$ level, thereby prolonging ER-stress and maintenance of pro-oxidant rich environment to induce HKM apoptosis and bacterial clearance.

1. Introduction

Mycobacterium fortuitum, rapid growing, nontuberculous mycobacterium, is known to infect a wide range of hosts, including both homeotherms and poikilotherms. It is one of the common etiologic agents of piscine mycobacteriosis and also reported to cause protracted illness in immuno-compromised and immuno-competent humans (Gauthier and Rhodes, 2009; Okamori et al., 2018). The clinical signs of piscine mycobacteriosis are non-specific and include emaciation, anorexia, stunted growth, ascites, neuronal disorders, exophthalmos, keratitis, dermal pigmentary changes, loss of scales, formation of scattered granulomas on both external surface and internal organs of body, and ultimately, death (Gauthier and Rhodes, 2009). Despite a diverse range of hosts, an in-depth understanding of molecular mechanisms of *M. fortuitum*-induced pathogenesis is still lacking.

TLRs represent an evolutionarily conserved group of receptors, expressed in a wide range of invertebrates and vertebrates (Roach et al., 2005). They are differentially expressed in immune and non-immune cells, exhibiting exquisite specificity for different pathogens or their products, and upon activation, triggers cascade of signalling events to elicit host defence pathways. TLRs play critical role in mycobacterial pathogenesis, among which the role of TLR-2 in mycobacterial immunity is well documented (Blanc et al., 2017; Drennan et al., 2004; Ishikawa et al., 2017). In this role, TLR-2 binds to a variety of mycobacterial ligands, facilitating phagocytosis and triggering the production of NF-kβ/MAPK-mediated pro-inflammatory cytokines, essential for inducing macrophage apoptosis and eliciting adaptive immune response against pathogens (Drennan et al., 2004; Sánchez et al., 2010). However,

Abbreviations: C. gariepinus, (*Clarias gariepinus*); *M. fortuitum*, (*Mycobacterium fortuitum)*; HKM, (Headkidney macrophage); $(Ca^{2+})_c$, (Cytosolic calcium); TLR-2, (Toll-like receptor 2); ER-stress, (Endoplasmic reticulum stress); SOCE, (Store-operated calcium entry); STIM1, (Stromal interaction molecule 1); Orai1, (Calcium release activated calcium channel protein 1); NOSIP, (Nitric oxide synthase interacting protein); $(O_2^{\bullet-})$, (Superoxide); NO, (Nitric oxide).

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TLR22-mediated activation of TNF-α-caspase-1/IL-1β inflammatory axis leads to apoptosis of *Aeromonas hydrophila*-infected macrophages

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ARTICLE INFO

Keywords:
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ABSTRACT

Toll-like receptors (TLRs) represent first line of host defence against microbes. Amongst different TLRs, TLR22 is exclusively expressed in non-mammalian vertebrates, including fish. The precise role of TLR22 in fish-immunity remains abstruse. Herein, we used headkidney macrophages (HKM) from *Clarias gariepinus* and deciphered its role in fish-immunity. Highest *tlr22* expression was observed in the immunocompetent organ – headkidney; nonetheless expression in other tissues suggests its possible involvement in non-immune sites also. *Aeromonas hydrophila* infection up-regulates *tlr22* expression in HKM. Our RNAi based study suggested TLR22 restricts intracellular survival of *A. hydrophila*. Inhibitor and RNAi studies further implicated TLR22 induces pro-inflammatory cytokines TNF-α and IL-1β. We observed heightened caspase-1 activity and our results suggest the role of TLR22 in activating TNF-α/caspase-1/IL-1β cascade leading to caspase-3 mediated apoptosis of *A. hydrophila*-infected HKM. We conclude, TLR22 plays critical role in immune-surveillance and triggers pro-inflammatory cytokines leading to caspase mediated HKM apoptosis and pathogen clearance.

1. Introduction

The key step for commencing immune defence mechanisms involves innate recognition of conserved pathogen-associated molecular patterns (PAMPs) and triggering of signalling cascades that culminate in the elimination of the pathogen. The innate immune system recognises PAMPs through germ-line encoded pattern recognition receptors (PRRs), thus serving as the first line of defence, both in vertebrates and invertebrates (Rauta et al., 2014) Amongst PRRs, Toll-like receptors (TLRs) were the first to be identified and best characterized (Kawasaki and Kawai, 2014). Besides playing an essential role in innate immunity, TLRs also regulate adaptive immune responses (Leulier and Lemaitre, 2008) as well as developmental and non-immune functions (Pasparakis et al., 2014; Anthoney et al., 2018).

Following recognition of specific PAMPs, TLRs trigger distinct cellular responses by recruiting TIR domain-containing adaptor proteins such as MyD88 (Myeloid differentiation primary response gene 88), TRIF (TIR-domain-containing adapter-inducing interferon-β), TIRAP/MAL (TIR-domain-containing adapter protein/ Myd88 adapter like) and TRAM (TRIF-related adapter molecule), which converge at NF-kB triggering pro- or anti-inflammatory cytokines, depending upon the cell type and ligands, they recognize. The pro-inflammatory cytokines induced *via* TLRs play a key role in inducing cell death and pathogen clearance (Weiss et al., 2004).

The number of TLRs varies in different species (Anthoney et al., 2018) and twenty different TLRs have been reported in fish (Rauta et al., 2014; Zhang et al., 2014). Among the different TLRs, TLR22 has been described in aquatic animals including amphioxus (Ji et al., 2018), fish and amphibians (Roach et al., 2005; Ishii et al., 2007). In fish, TLR22 was first identified in *Carassius auratus* (Stafford et al., 2003) and thereafter in several marine and freshwater fish (Reyes-Becerril et al., 2015; Kole et al., 2017). The role of TLR22 in fish immunity is not well understood. The receptor has been identified both in immune and non-immune tissues suggesting its functional plurality (Gong et al., 2017). It shares a significant resemblance with TLR3 in cellular localization and molecular function (Pietretti and Wiegertjes, 2014). Initial

Abbreviations: C. gariepinus, *Clarias gariepinus*; *A. hydrophila*, *Aeromonas hydrophila*; HK, Headkidney; HKM, Headkidney macrophages; TLR22, Toll-like receptor 22; TNF-α, Tumour necrosis factor-α; IL-1β, Interleukin-1β.

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Full Length Article

M. fortuitum-induced CNS-pathology: Deciphering the role of canonical Wnt signaling, blood brain barrier components and cytokines

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ABSTRACT

Molecular underpinning of mycobacteria-induced CNS-pathology is not well understood. In the present study, zebrafish were infected with *Mycobacterium fortuitum* and the prognosis of CNS-pathogenesis studied. We observed *M. fortuitum* triggers extensive brain-pathology. Evans blue extravasation demonstrated compromised blood-brain barrier (BBB) integrity. Further, decreased expression in tight-junction (TJ) and adherens junction complex (AJC) genes were noted in infected brain. Wnt-signaling has emerged as a major player in host-mycobacterial immunity but its involvement/role in brain-infection is not well studied. Sustained expression of *wnt2*, *wnt3a*, *fzd5*, *lrp5/6* and *β-catenin*, with concordant decline in degradation complex components *axin*, *gsk3β* and β-catenin regulator *capn2a* were observed. The surge in *ifng1* and *tnfa* expression preceding *il10* and *il4* suggested cytokine-interplay critical in *M. fortuitum*-induced brain-pathology. Therefore, we suggest adult zebrafish as a viable model for studying CNS-pathology and using the same, conclude that *M. fortuitum* infection is associated with repressed TJ-AJC gene expression and compromised BBB permeability. Our results implicate Wnt/β-catenin pathway in *M. fortuitum*-induced CNS-pathology wherein Th1-type signals facilitate bacterial clearance and Th2-type signals prevent the disease sequel.

1. Introduction

M. fortuitum, non-tuberculous, rapidly growing mycobacteria is present in aquatic and soil habitats (Okamori et al., 2018). It is capable of forming biofilms (Hall-Stoodley and Lappin-Scott, 1998) and causing pathological manifestations in both cold- and warm-blooded animals (Williams et al., 2009). It has been observed that in fish, it causes piscine mycobacteriosis (Gauthier and Rhodes, 2009). The clinical signs of piscine mycobacteriosis are non-specific and include emaciation, anorexia, stunted growth, ascites, neuronal disorders, exophthalmos, keratitis, dermal pigmentary changes, loss of scales, and skin ulcers (Gauthier and Rhodes, 2009). Internally, the development of grey-white nodules on the surfaces of different parenchymal organs and presence of single or multiple granulomatous lesions are considered hall-mark of the disease (Gauthier and Rhodes, 2009).

Due to rapid growth and resistance to a wide range of anti-mycobacterials, *M. fortuitum* is a pathogen of concern (Goswami et al., 2017; Hatakeyama et al., 2017). The information on pathogenic determinants and virulence mechanisms of *M. fortuitum* is limited and primarily confined to mammals. It has been observed that like other pathogenic mycobacteria, *M. fortuitum* can suppress IFN-γ-induced nitric oxide production and inhibits phagosomal maturation for survival inside mammalian macrophages (Da Silva et al., 2002). It induces the production of reactive oxygen species (Helguera-Repetto et al., 2014) which in turn triggers apoptosis of infected macrophages (Datta et al., 2016). There are also reports of *M. fortuitum* infection leading to the development of granuloma (Talaat et al., 1999; Parti et al., 2008). Recently, *M. fortuitum* infection in zebrafish is shown to recapitulate several aspects of other pathogenic mycobacterial infection (Johansen and Kremer, 2020).

Mycobacteria can infect the brain causing CNS-pathology (Thwaites et al., 2013; Donovan et al., 2020). It is a rare and serious complication

Abbreviations: M. fortuitum, *Mycobacterium fortuitum*; GSK3β, Glycogen synthase kinase 3β; TJ, Tight junction; AJC, Adherens junction complex; BBB, Blood Brain Barrier; ZN, Zeihl-Neelson; CFU, Colony forming units; DEPC, Diethyl pyrocarbonate.

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mtROS Induced *via* TLR-2-SOCE Signaling Plays Proapoptotic and Bactericidal Role in *Mycobacterium fortuitum*-Infected Head Kidney Macrophages of *Clarias gariepinus*

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The mechanisms underlying *Mycobacterium fortuitum*-induced mycobacteriosis remain unexplored. Using head kidney macrophages (HKM) from catfish (*Clarias gariepinus*), we report that Ca^{2+} surge across mitochondrial-Ca^{2+} uniporter (MICU), and consequent mitochondrial ROS (mtROS) production, is imperative for mycobactericidal activity. Inhibition of mtROS alleviated HKM apoptosis and enhanced bacterial survival. Based on RNA interference (RNAi) and inhibitor studies, we demonstrate that the Toll-like receptor (TLR)-2–endoplasmic reticulum (ER) stress–store-operated calcium entry (SOCE) axis is instrumental for activating the mt-Ca^{2+}/mtROS cascade in *M. fortuitum*-infected HKM. Additionally, pharmacological inhibition of mtROS attenuated the expression of *CHOP*, *STIM1*, and *Orai1*, which suggests a positive feedback loop between ER-stress-induced SOCE and mtROS production. Elevated tumor necrosis factor alpha (TNF-α) levels and caspase-8 activity were observed in HKM consequent to *M. fortuitum* infection, and our results implicate that mtROS is crucial in activating the TNF-mediated caspase-8 activation. Our results for the first time demonstrate mitochondria as an innate immune signaling center regulating mycobacteriosis in fish. We conclude that *M. fortuitum*-induced persistent SOCE signaling leads to mtROS production, which in turn activates the TNF-α/caspase-8 axis culminating in HKM apoptosis and bacterial clearance.

Keywords: *M. fortuitum*, head kidney macrophage, TLR-2, ER stress, SOCE, mtROS, apoptosis

INTRODUCTION

Mycobacterium fortuitum, atypical, rapidly growing, acid-fast mycobacteria, is one of the causative agents of mycobacteriosis. The occurrence of multidrug-resistant strains (1) along with its impact on aquaculture and zoonosis (2) makes it a pathogen of concern. Incidences of *M. fortuitum* infections in humans have also been reported (3). Even though the bacterium is known to infect a

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ORIGINAL RESEARCH ARTICLE

Influence of lufenuron on the nutrient content and detoxification enzyme expression in *Aedes aegypti* L. (Diptera: Culicidae)

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Abstract

Aedes aegypti is of utmost public health concern transmitting various diseases of human health concern. Employment of chemical-based control interventions has induced immunity in mosquitoes, harmed environment, and adversely affected human health and non-targets diverting the research focus on alternate measures. Current study investigates the efficacy of an Insect Growth Regulator, lufenuron, against early fourth instars of *Ae. aegypti.* The larvae exposed to lufenuron for 24 h were assessed for the effects on the development and adult emergence. The impact of sub-lethal and median-lethal dose of lufenuron was determined on the nutrients and detoxification enzymes of *Ae. aegypti.* The larvae exposed to lufenuron showed reduced adult emergence exhibiting the respective IE_{30} and IE_{50} as 0.13 µg/L and 0.96 µg/L. Larval treatment with IE_{30} and IE_{50} lufenuron reduced the carbohydrate and lipid content in *Ae. aegypti.* However, the protein levels in the larvae decreased only on exposure to IE_{30} lufenuron while increased with IE_{50} lufenuron. Besides, IE_{30} and IE_{50} lufenuron treatment elevated α-esterases (1.05-fold; 1.15-fold); β-esterases (1.29-fold;1.62-fold), and Glutathione-S-transferases (1.19-fold; 3.1-fold) expression in the *Ae. aegypti* larvae. The % acetylcholinesterase inhibition also reduced by 3.75-fold and 2.07-fold, correspondingly, while the cytochrome P450 monooxygenase expression rose (1.15-fold) only with IE_{50} dosage of lufenuron. It is suggested that lufenuron stress probably ampliflied the catabolism of nutrients and expression of metabolic detoxifying enzymes in *Ae. aegypti* larvae in order to meet higher energy requirements and counteract the adverse effects of lufenuron. This is the first ever report unravelling the effect of lufenuron on the biochemical parameters of *Ae. aegypti* larvae.

Keywords *Aedes aegypti* · Detoxifying enzymes · Insect growth regulators · Lufenuron · Metabolism · Nutrients

Introduction

The dengue fever mosquito, *Aedes aegypti* prevalent worldwide, particularly in the tropical and subtropical regions, transmits several viral diseases; such as dengue, dengue haemorrhagic fever, chikungunya, yellow fever and Zika, and thus, poses major health concern among human beings (Benelli and Mehlhorn 2016). Among these diseases, dengue is the most prevalent ailment with cases reported in more than 100 countries. The South East Asia, United States of America and the Western Pacific countries are the most seriously impacted regions; Asia accounting for approximately 70% of the global disease burden (World Health Organisation 2020). In India, the Directorate of National Vector Borne Disease Control Programme (NVBDCP) has recorded a total of 1,01,192 dengue cases and 172 deaths during the year 2018; while 1,57,315 cases and 166 fatalities in the year 2019 (NVBDCP 2020). Ironically, these numbers do not reflect the actual number of dengue cases due to the occurrence of numerous asymptomatic, mild and even self-managed cases (Waggoner et al. 2016).

For a long time, various attemps have been made to minimize mosquito population density, at both larval and adult stage, yet, larvicidal measures are regarded as the ideal methods due to their localized mobility and confinement to small aquatic habitats (Killen et al. 2002). Despite

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Assessment of Toxicity and Growth Regulatory Effects of Beta-Cyfluthrin Against Red Cotton Bug, *Dysdercus koenigii* (Fabr.) (Hemiptera: Pyrrhocoridae): An Emerging Cotton Pest

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ABSTRACT
Red Cotton Bug, *Dysdercus koenigii* (Fabr.) (Hemiptera:Pyrrhocoridae), commonly called cotton stainer, is a damaging pest of cotton and other economical crops in Asia. Nymphs as well as adult of this pest suck the sap from the green bolls and leaves of cotton causing shedding of young bolls, rotting of green bolls, stained cotton fibers and loss of seed viability. The present study evaluates the toxic and growth regulatory effects of a pyrethroid, beta-cyfluthrin against *D. koenigii*. The newly emerged fifth instars nymphs were exposed to beta-cyfluthrin at concentration ranging from 0.00008% to 0.00128%. A volume of 1µL of beta-cyfluthrin was topically applied on the dorsal anterior thoracic region of nymphs (in 3 replicates, each replicate containing batch of 25 insects) and were observed for mortality after 24 hr. The nymphs were further reared till adults to observe delayed toxicity effects and developmental abnormalities, if any. The result revealed significant lethal effects of beta-cyfluthrin on *D. koenigii* nymphs with LD_{50} and LD_{70} values as 0.00051% and 0.00076%, respectively. A positive correlation was observed between percent nymphal mortality of *D. koenigii* and the dose of insecticide. The survived nymphal instars developed several development malformations; partial moulting, shrunk abdomen, abnormal adults with deformed wing, adultoids and adults with attached exuviae. Further studies are being conducted to assess the development of beta-cyfluthrin resistance in *D. koenigii* and strategies to counter resistance. These results can provide an important base for developing effective and desired strategies to control and monitor insecticides resistance in *D. koenigii.*

Keywords*:* Dysdercus koenigii, *mortality, beta-cyfluthrin, adultoids, developmental abnormalities*

1. INTRODUCTION

Cotton is one of the major fibres and cash crops grown not only in India but also throughout the world. It plays an important role in the economic growth of industries and agriculture sector of the country. India with approximately 12 million hectares land under cotton production is one of the largest producers of cotton in the world [1] which accounts for 27% of the world cotton production. Around 10 million farmers are engaged in the production of cotton; while about 30 million individuals are employed in cotton industry, its processing and final production [2]. However, the cotton cultivation faces severe pest attacked resulting in low production and major losses. Although worldwide, 1326 species of insect pests have been reported on this crop, it is known to be susceptible to about 162 species [3]. Among these pests leading to the low cotton produce, the enormous attack of sucking insect pests plays the significant role [4]. In addition, the large-scale introduction of *Bt*-transgenic cotton to reduce the usage of insecticides against other cotton pests; *Helicoverpa armigera*, *Earias spp*., and *Pectinophora gossypiella* [5]; has led to the emergence of sucking pest; *Dysdercus koenigii* [6].

D. koenigii is one of the most notorious bugs of cotton. Also known as red cotton stainer; it belongs to order Hemiptera, family Pyrrhocoridae, and is a disastrous cotton pest in several parts of Asia [7, 8]. Both nymph and adults feed on developing cotton bolls and seeds within them resulting in diminished oil quantity and viability of the seeds [9]. Furthermore, adult excreta stain the cotton yellow that adversely affects the colour of cotton lint. The infested cotton bolls become prone to fungal and bacterial infections, which make their way into the bolls through the punctures made by insects while feeding [10]. The rapid multiplication of the pest in the fields due to short life cycle in comparison to lepidopteran pests aggravates its seriousness [11].

Currently, chemical insecticides are the key tools to manage insect pests in almost all cropping systems around the world [12]. Thus, like other pests, *D. koenigii* has also been controlled by using various chemical globally. Since last few decades, pyrethroids, an important group of

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Biochemical Characterization of Acetamiprid Resistance in Laboratory-Bred Population of *Aedes aegypti* L. Larvae

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ABSTRACT
The constant rise in cases of Zika, Dengue and Chikungunya worldwide has made control of *Aedes aegypti* a principal concern. The most recommended plan to control mosquito-borne diseases primarily lies on vector management and disturbing their disease-transmission cycle. Wide-ranging use of different classes of organic insecticides for mosquito control has led to the development of high levels of resistance making them less operative at safe dosages imposing us to explore novel insecticides. Present study investigates the bio-efficacy of a neonicotinoid, acetamiprid on the *Ae. aegypti* larvae, development of resistance after subjecting acetamiprid selection pressure for 10 successive generations and biochemical characterization of the resistance developed. Acetamiprid exposure of the parent population of *Ae. aegypti* early fourth instars resulted in respective LC_{50} and LC_{90} values of 0.188 ppm and 1.315 ppm. Selection with acetamiprid for 10 successive generations (ACSF-10) reduced its efficacy by 20-fold. Involvement of four enzymes; alpha-esterases, beta-esterases, glutathione-S-transferases and acetylcholinesterases in development of acetamiprid resistance was investigated to uncover mode of action of acetamiprid. An elevation of 1.4-fold and 2.1-fold was observed in alpha-esterases and beta-esterases activity in ACSF-10 as compared to ACSF-5. However, activity of glutathione-S-transferases decreased in ACSF-5 which rose to 12-fold in ACSF-10. Similarly, the activity of acetylcholinesterases was found to be much higher in resistant generations as compared to the parental strains. The results indicated individual/synergistic contribution of different enzymes leading to acetamiprid detoxification. Further research is being conducted to identify the role of target site mutations in resistance development.

***Keywords**:* Aedes aegypti, *acetamiprid, esterases, glutathione-S-transferase, acetylcholinesterases*

1. INTRODUCTION

The WHO global strategy for dengue prevention and control by 2020 is based on the fact that almost half of the world population resides in dengue-prone area; resulting in 50 to 100 million estimated annual dengue infections. Currently, approximately 75% population of Asia-Pacific region is exposed to dengue. The actual number of cases of dengue is even worse, because of severe underreporting and misclassification [1, 2]. In addition, most countries in Southeast Asia with endemic malaria are experiencing increased *Aedes*-borne diseases due to ecological changes arising from poorly controlled population movement and extensive exploitation of natural environments.

The prevention of dengue transmission primarily depends on reduction of the human-vector contact using residual chemical compounds; while dengue infection can be kept under check by accurate diagnosis and prompt effective treatment [3, 4]. For decades, DDT was used in mosquito vector control programs as an inter-domiciliary spray; which was gradually discontinued because of social and environmental concerns. The organochlorines were then replaced with organophosphates followed by synthetic pyrethroids. Since then, pyrethroids have been used extensively for the insecticide treatment of bed nets (ITN) and as indoor residual sprays (IRS) in many parts of the country. However, repeated contact with these insecticides has led, in some cases, to high levels of resistance in vector populations. The increased development of mosquito resistance to pyrethroids is of particular concern for many integrated mosquito control programs that utilize insecticides for vector control [5].

Despite extensive research in the field, management of insecticide resistance remains the major challenge in mosquito control leading to the need of developing strategies which could ensure long-term efficacy of toxicants and; delay or prevent the development of resistance. Identification and introduction of new insecticides in the fields with mosquito control potential and novel mode of action has become a major task in front of the researchers. Neonicotinoids are among such

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Lufenuron: A Potential Chitin Synthesis Inhibitor Against *Aedes aegypti* L.

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ABSTRACT
Chemical control of dengue vector, *Aedes aegypti* is impaired due to development of resistance to conventional insecticides. Insect Growth Regulators (IGRs) are considered more suitable and effective vector control agents as they specifically inhibit chitin biosynthesis, a process absent in vertebrates, and impose less adverse effects on beneficial insects and the environment. Present study investigates Lufenuron, a Chitin Synthesis Inhibitor (CSI), as a control agent of *Ae. aegypti*. Different instars of *Ae. aegypti* were exposed to a range of concentrations of Lufenuron as per WHO protocol. The investigations showed the effective hormone-mimetic effect of Lufenuron resulting in the formation of a significant number of larval-pupal and pupal-adult intermediates with the maximum number observed on exposure to L3 (L-P=17%, P-A=21%). Approximately 20% of L2 instars either could not moult and remained trapped inside the new exuviae or possessed bulged abdomen while some showed ruptured exoskeleton. The results showed increase in IE_{30} from L1 (0.00010 ppm) to L4 stage (0.00013 ppm); the L2 stage exhibiting maximum IE_{30} (0.00025 ppm). The median emergence suppression (IE_{50}) doses of the Lufenuron were found to be 0.00057 ppm for L1, 0.00047 ppm for L2, 0.00050 ppm for L3 and 0.00096 ppm for L4. The results also revealed increased duration of larval development and inability of pupae to develop into adults, as compared to the controls. The investigations indicate the potential use of Lufenuron as the control agent of *Ae. aegypti*. Further research is being conducted to understand its mode of action to develop effective control strategies.

***Keywords**:* Aedes aegypti, *growth inhibition, intermediates, Lufenuron, hormone-mimetic*

1. INTRODUCTION

Dengue, yellow fever and Chikungunya are the most prevailing diseases worldwide, responsible for millions of deaths each year [1]. *Aedes aegypti* has been the most devastating vector in last few decades and plays the major vector in spreading these diseases [2]. The World Health Organization has reported a global estimate of 3.9 billion people inhabiting 128 countries facing risk of dengue infection while 60 countries were identified as the Chikungunya-prone areas by WHO [3]. The dengue/dengue haemorrhagic fever data recorded by NVBDCP (National Vector Borne Disease Control Programme), India showed a total of 1,29,166 cases and 245 deaths in the year 2016 which shot up to 1,88,401 cases and 325 deaths in 2017. In November 2018, though a decline to 89,974 cases and 144 deaths was observed; the total data is yet to be reported [4].

Primary control measures of the mosquito vectors have mainly been focused on the use of insecticides, primarily those which target the insect central nervous system. Nevertheless, the indiscriminate use and rising reports of resistance development in the vector population to these insecticides has led to the consequent failures of control efforts [5]. Thus, new and effective tools have to be taken into consideration and identified for the control of these important disease vectors.

A recent approach to insect pest control is the use of substance with distinct mechanism of action. Substances like Insect Growth Regulators (IGRs) have a selective mode of action as compared to other synthetic insecticides. Synthetic insecticides; like organophosphates and carbamates; interfere with various physiological processes of insects, while IGRs act on the target species by adversely affecting their growth and development leading to developmental abnormalities impairing the survival of insect [6, 7]. Apart from this, these compounds are considered safer to the non-target organisms than conventional insecticides [8].

Based on the mode of action, IGRs can be grouped into two types: chitin synthesis inhibitor (CSI) and substances that interfere with the action of insect hormones [6]. CSIs are benzoylphenyl urea compounds and were first discovered in the 1970s [9]; they can affect reproduction and development of organisms to varying degrees. Insect larvae treated with CSIs fail to ecdyse because of the inhibition of cuticle synthesis even if moulting occurs [6]. These compounds can also prevent the formation of adequate peritrophic membrane (PM) lining the insect gut [10], which consequently disturbs the

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RESEARCH

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Quaternionic quantum mechanics for $N=1$, 2, 4 supersymmetry

Seema Rawat[1*] and A. S. Rawat[2]

Abstract

Background: Quaternions have emerged as powerful tools in higher-dimensional quantum mechanics as they provide homogeneous four-dimensional structure in quantum field theories, offer compact representations, and incorporate spin naturally. Quantum field theories then lead to the unification of fundamental interactions so the use of quaternion becomes necessary when we are dealing with higher-dimensional theories. On the other hand, supersymmetry is the theory of bosons and fermions and is an essential constituent of grand unified theories. The use of quaternion in supersymmetric field theories provides an excellent framework for higher-dimensional unification theories.

Result: A complete theory for supersymmetric quaternionic quantum mechanics has been constructed for N = 1, 2, 4 supersymmetry in terms of one, two, and four supercharges and Hamiltonians, respectively. It has been shown that $N=4$ SUSY is the quaternionic extension of the $N=2$ complex SUSY and $N=1$ real SUSY; also spin is the natural outcome of using quaternion units. Pauli and Dirac Hamiltonian and their relationship have also been obtained in quaternion space. It has been shown that quaternionic quantum mechanics are superior to ordinary and complex quantum mechanics because in the quaternion framework we do not need three different theories for $N=1,2,4$ SQM but a single theory only.

Conclusions: It has been concluded that $N=1$ real SUSY is equal to $N=2$ complex SUSY which in turn is equal to $N=4$ quaternion SUSY so one can arrive at higher-dimensional quantum field theories starting from lower-dimensional quantum theories. Higher-dimensional quaternion field theories are suitable for nonphotonic light cone particles which are not allowed in complex QFT, also noncommutative nature of quaternion gives an extra degree of freedom and may provide the possibility of some new particle, dark matter, or new phenomenon. Though quaternions provide an excellent framework in higher-dimensional field theories, there are certain challenges due to their noncommutativity as calculations become tedious where large terms are involved. Keeping in view the noble features of quaternion, we expect some development to get a better understanding of $N=8$ supergravity, maximal supergravity ($D=11-n$), and maximal supersymmetry theories ($N=10$) in terms of quaternion operators.

Keywords: Supersymmetry, Quaternion, Relativistic quantum mechanics, Quantum field theories

1 Background

In recent years, quaternions have emerged as powerful tools in higher-dimensional quantum mechanics as they provide homogeneous four-dimensional structures in relativistic quantum mechanics and provide representations in terms of compact notations [1–3]. Also, spin is a natural outcome of using quaternion as they are represented in terms of Pauli spin matrices [4, 5] so their use becomes necessary while dealing with nonzero spin particles. Quaternion product is noncommutative so we get an extra degree of freedom in expressions which can lead to some new phenomenon, particles, and explanations of some undefined questions in particle physics [6,

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Dye degradation study of Malachite green and Congo red by using $ZnIn_2S_4$

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Abstract
In this manuscript, we demonstrate photocatalytic study of $ZnIn_2S_4$ powder sample under visible light irradiation on Malachite green and Congo red dye. The powder sample was synthesized usingIndium (III) sulphate,thioacetamide andZinc sulphate in aqueous solution. X-ray diffraction and FESEM were used to identify the hexagonal crystal structure and microspheres shape, while UV-Vis spectroscopy was used to acquire absorption and reflectance spectra under visible-light (λ= 420 nm) irradiation, the effects of process factors such as contact duration and adsorbent dose were studied on Malachite green and Congo red. Degradation efficiency of Malachite green and Congo red are 96.33%, 99.79% respectively.The results revealed that visible light photocatalytic degradation of dyes was highly efficient.

Key words: $ZnIn_2S_4$; Visible-light irradiation, Malachite green (MG), Congo red (CR)

1. Introduction

From last few years a great interest aroused for the investigation of photocatalytic dye degradation because lost about 15% of total production in worldwide. Peoples are also affected because due to cause of polluted water containing dye also creates a worldwide problem. Another various organic dyes methyl orange, malachite green, congo red are also very harmful and can be used as an antimicrobial and antifungal containing heavy water pollutant which are very toxic, affected for environment [1-3]. In order to remove these problems continuous search from last few decades to find the suitable and efficient catalysts to degrade of dye contaminants. To overcome this problem semiconductor photocatalytic and another nanostructured materials such as ZnO, TiO, andCds etc. because of their low cost and ecofriendly nature [4-7]. Out of which several are broadly investigated. These photocatalytic catalyst absorb photon in the range of UV due to containing a large band gap [8]. After tremendous effort we find a new micro/Nano catalytic $ZnIn_2S_4$ to remove pollutants of organic/inorganic pollutants, have a low cost, more efficient and synthesis by a simple root method in water solution. $ZnIn_2S_4$ have two polymorphous have been reported at hexagonal and cubic lattices [9]. $ZnIn_2S_4$ is degraded in the visible light range and widely use in photocatalytic applications [10]. In this work, Zinc Indium Sulphate powder sample was successfully synthesis by simple root method at low temperature. The crystal structure, morphology and photocatalytic activity of zinc indium sulfate were investigated. The effect of contact time and absorbent amount on Malachite green and Congo red in photocatalytic reaction was studied.

2. Synthesis method

$ZnIn_2S_4$ photocatalysts were made in aqueous solution at low temperatures using $ZnSO_4$, $In_2(SO_4)_3$, and thioacetamide (TAA). The quantities of Zinc Sulphate (4.0 mmol), Indium Sulphate (4.0mmol), and Thioacetamide (20.0 mmol) are dissolved in 250 ml flask of D.I water (80ml) which was sealed partially and placed at 80^0C in water bath for a specific duration of four hours. After final suspension, it was cool down at room temperature for four hours, and then final solution was filtered many times by DI-water and ethanol. After filtration sample dried for six hours at 60^0C in muffle furnace, and then collected sample was grinded by motor pestal. The final product essential for the study of dye degradation.

3. Characterization

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Synthesis of marigold-like $ZnIn_2S_4$ microspheres at low-temperature

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Highlights

- Low-Temperature and Template-Free Synthesis of marigold-like $ZnIn_2S_4$ Microspheres.
- Characterization of the synthesized marigold-like $ZnIn_2S_4$ Microspheres powder with XRD, FESEM, UV–vis. Spectroscopy and XPS.
- The band gap of $ZnIn_2S4$ (2.31 eV) is in

A New Modus Operandi for Determining Post - IPO Pricing : Analysis of Indian IPOs Using Artificial Neural Networks

Amit Kumar Singh[1]
Mukesh Kumar Jain[2]
Saksham Jain[3]
Bhavesh Gupta[4]

Abstract

The objective of this study was to identify different factors useful in determining post-IPO pricing and test their relative significance by comparing stock performance across 3-, 6-, and 12-months post listing.To do so, the study analyzed data from 299 non-financial companies that had their IPOs listed on the Bombay Stock Exchange from 2005 – 2018 in India. The data collected were used to train a neural network, called the multilayer perceptron model. The study grouped all factors into four categories viz-a-viz macroeconomic, issue-specific, technical, and fundamental. Analysis of the results generated from 20 iterative constructions of the neural network revealed that the highest relative relevance in prediction was attributed to technical factors. It was also observed that the importance of fundamental factors increased with the investment horizon. The results are country-specific and found that the importance of "underpricing" and "listing gains" as factors reduced within a year post-listing and thus, provide a helpful addition to the present knowledge of financial gains resulting to investors from IPOs.

Keywords **: initial public offering, artificial neural networks, multi-layer perceptron, Post-IPO performance**

JEL Code : C45, G11, G12, G14

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The price of an IPO can be based on the fundamental valuation, a discount, other explainable, and numerous inexplicable factors related to expectations. While deciding for an investment in an IPO, the investors usually are in a dilemma about the post-listing performance as well as the long-term performance of a company because generally, no substantial information and analysis are readily available about the past performance of a firm. The investors, especially retail, have to depend only on the limited financial data, news that is publicly available, and the moves of the institutional investors. It is quite difficult for them to focus and analyze

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Article

Information Spillover in Indian Agricultural Commodities Market

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Sanjay Kumar Singh[1], Mukesh Kumar Jain[2] and Shoeba[2]

Abstract

Role of agricultural sector in Indian economy is prominent, as being an agrarian economy and having the second highest population in the world. Thus, the efficiency of this sector is the foremost factor for development and growth of the economy. This article attempts to examine the price discovery relationship of future and spot prices of five agricultural commodities, namely cardamom, crude palm oil, cotton, mentha oil and *kapas*, during the period 2011–2019. Johansen's co-integration test, vector error correction model (VECM) and Granger causality block exogeneity test were employed for the study. We found that price discovery process is established for agricultural commodities under consideration. Future prices act as a leader in achieving long-run equilibrium for all commodities except cardamom. Causality was significantly reported for all commodities, as bidirectional causality runs between the prices. The study suggests that Forward Market Commission should be empowered more to control and regulate the market, which will ensure the efficient market situations in these commodities' market. Attempt was made to evaluate price discovery process in agricultural commodities market during post sub-prime crisis period, which was ignored by majority of researchers.

Keywords

Price discovery, Johansen's co-integration, bidirectional causality, Forward Market Commission

Introduction

Indian commodities market has exhibited remarkable performance since its inception, although development and progress of organised derivatives market of commodities is comparatively a recent phenomenon. Indian commodities markets have a very long and disturbing history ranging over a century, in comparison to the USA and the UK. The incorporation of the Bombay Cotton Trade Association Ltd in 1875 marked the beginning of India's structured form of trading in derivatives. Next to cotton, future trading for oil seeds, initiated in 1990 with the incorporation of Gujrat Vyapari Mandali, carried out groundnut, cotton and castor seed; future exchange at Hapur was established for wheat, which always represented as wheat's price setter for whole of the country. In 1919 and 1927, two organisations were established, Calcutta Heissan Exchange Ltd. and the East India Jute Association, to conduct future trading for raw jute and jute products. Later in 1945, these two associations were amalgamated to carry organised trading in jute and its products. The Bombay Bullion Cotton Association was set up in 1920, for trading in derivatives of gold and silver. In 1921, East India Cotton Association (EICA) started cotton future trading in Mumbai. Meanwhile, numerous exchanges were developed in India to conduct future trading of various commodities.

These markets followed the rules and regulations laid down by their trade associations. As different associations laid down their own policies, it resulted in a range of disputes among traders in different associations. As a result, there was requirement of some regulatory body for their good management. Subsequently, Bombay Forward Contracts Control Act was passed in 1947 to fulfil the need. The issue of Stock Exchange and Future Markets was placed under the Union List after independence and ratification of the Constitution in 1950, thereby establishing the production and regulation of future commodity markets as the central government's sole responsibility. The Forward Contract Act had entered into force in 1952 through the efforts of a specialist committee led through Shri A. D.

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RESEARCH ARTICLE

HEAT TRANSFER WILEY

Heat and mass transfer analysis of combined convection in a horizontal rectangle

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Abstract

In this study, the heat and mass transfer of combined free and forced convection in the horizontal rectangle is explored. The governing equations together with the boundary conditions are solved numerically by using the finite volume method. The innovative idea in this study is to appropriately modify the Semi-Implicit Method for Pressure-Linked Equations algorithm and thereby, the numerical solutions of the flow variables such as the temperature and the concentration in addition to the components of velocity and the pressure are computed. The Richardson numbers (Ri) for distinct gases and liquids are calculated for different Rayleigh numbers at low ($Re = 50$) and high ($Re = 5000$) Reynolds numbers. The dimensionless parameters, such as the Reynolds number (Re), the Prandtl number (Pr), and the Schmidt number (Sc) are appropriately chosen to calculate the Richardson numbers. Consequently, combined free and forced convection effects are analyzed. Furthermore, the heat and mass transfer aspect for distinct gases and liquids is critically examined using empirical correlations. The accuracy and the validation of these results are ensured owing to the solutions obtained from correlations being advised in this study and those are existing in the literature.

KEYWORDS

average Sherwood number, heat and mass transfer, Rayleigh number, Reynolds number, Richardson number, Schmidt number

JEL CLASSIFICATION

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Some new aspects of graph labeling in dental arch structure

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ABSTRACT

In the field of graph theory, graph labeling used in various field with its application used in different fields like coding theory, radar, security deign, x-ray crystallography, communication networking etc. In this paper we used the graph labeling in the field of dental arch. This paper gives the idea of graph labeling in dental field. We have to try different types of graph labeling techniques on the structure aspects of the dental arch and it teeth.

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1. Introduction

A graph $G = (V_G, E_G)$ is a combination of vertices and edges where $V_G$denote the all vertices of graph $G = (V_G, E_G)$ and $E_G$denote the edges of the graph $G = (V_G, E_G)$ provided if each edge $e = (uv)$ gives the value $\phi(uv) = \phi(u) * \phi(v)$ (u *and* v are the end points of the edge e) where ϕ is an injective mapping from the vertex set $V(G)$ to the set of non-negative integer $\{0, 1, 2, 3, ..., n\}$ and * is the binary operation. Here * can be represented as either of addition, multiplication, subtraction or absolute difference. Graph labeling is the assignment of integers for the vertices and edges of the graph respectively with a certain condition that the labels of the graph are distinct where repetitions are not allowed.

The notion of graph labeling technique is spread into existence of long period of a mathematical analysis and investigation and therefore the first definition of graceful labeling came into existence due to Rosa [7] in 1967 and then by Golomb [3]. If a function ϕ is an injective function from the vertices of graph G to the set $\{0, 1, 2, 3, ..., n\}$ i.e. $\phi : V(G) \to \{0, 1, 2, 3, ..., n\}$such that when each edge $e = uv$assigned to the label $|\phi(u) - \phi(v)|$ in which the resulting edge labels are distinct, such labeling are called graceful [1,2,4–6,8,9].

The graph labeling concept in graph theory has become a great area of research now days. The several graph labeling techniques and their useful application in many real world problems has already been explained by Kumar and Pradhan and can be found in [8–11].

2. Graceful labeling of some family of graphs

In this section, we define graceful labeling for dental arch and use different type of graph labeling to prove that the application of graph labeling in dental architecture.

2.1. Graceful labeling for dental arch

The concept of dental arch is based on architecture of tooth in which we assume that each teeth of dental arch are the vertices and whenever we join this vertex of dental arch we get the edges of this architecture. In this paper, we work on the architecture of dental arch and apply the different type of labeling on this concept and apply the application of graph labeling in dental architecture. We use different type of graph labeling on dental arch and find the different result based on graceful labeling.

If We divide the dental arch in to two parts in which one is upper arch and other is lower arch. In total there are $\frac{n}{2}$ teeth on either side of the dental arch summing to a total of n teeth where-$n$is always even. Let each teeth of the arch is considered as a vertex and edges are formed by a line joining the adjacent teeth and same type of teeth in left and right side.

Graceful labeling is applied in this graph by taking the vertex set from $\phi : V(G) \to \{0, 1, 2, ..., |E|\}$and the edge set from

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Graceful distance labeling for some particular graphs

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Abstract

In this paper, we define a new type of labeling for graphs which we call graceful distance labeling (GDL). An injective mapping f from the vertex set $V(G)$ into the set of non-negative integers such that the absolute difference of labels of vertices u and v is greater than or equal to distance between them i.e. $|f(u)-f(v)| \geq d(u,v)$ where $d(u,v)$ denotes the distance between the vertices u and v in G. The graceful distance labeling number (GDLN), $\lambda_d(G)$ of G is the minimum k where G has a graceful distance labeling f with k being the absolute difference between the largest and smallest image points of f i.e. $\lambda_d(G) = \min k$, where $k = \max|f(u)-f(v)|$. In this paper, we find the values of k for different graphs.

Keywords

GDLN, hairy cycle, corona of graphs, double graphs.

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Contents

1. Introduction

Most of the labeling techniques trace their origin to a paper of Rosa [9]. For a simple, connected and undirected graph $G(V,E)$ with n vertices, a graceful distance labeling (GDL) with span k is an injective function $f : V(G) \to \{0,1,2,\ldots,k\}$ such that $|f(u)-f(v)| \geq d(u,v)$ where $d(u,v)$ denotes the distance between the vertices u and v in G. The span k over f is the largest number in $f(V)$ i.e span $(k) = \max f(v)$. The minimum span k taken over all graceful distance labeling of G denoted as $\lambda_d(G)$ is called graceful distance labeling number (GDLN) [1],[3],[4],[6],[8].

2. Preliminaries

GDL Algorithm for a graph:

In this section, we develop an algorithm for giving the GDL to a simple, connected and undirected graph $G(V,E)$ from the set $Z_+ = \{0,1,2,\ldots\}$. The steps of the algorithm are given below:

Step 1: assign zero to one of the vertex which has maximum diameter.

Step 2: remove 0 from the set $\{0,1,2,3,\ldots\}$

Step 3: assign 1 to one of the vertex which is adjacent to the vertex with zero label.

Step 4: remove 1 from the set $\{1,2,3,\ldots\}$

Step 5: continue this process until all the vertices have the distinct labels.

For example: GDL of a tree is shown in figure 1.

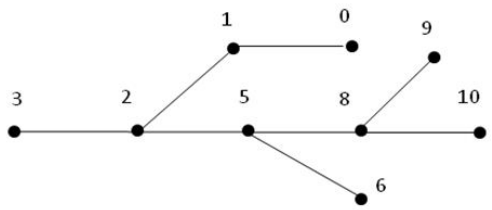

Figure 1. GDL of a tree with 9 vertices

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G-GRACEFUL LABELING OF GRAPHS

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AND YOGESH KHANDELWAL

ABSTRACT. After a long period of scramble over analysis and investigations, the notion of graceful labeling came into existence. A mapping f for a graph $G = (R, S)$ is said to be graceful if there exists a bijective mapping $f : R(G) \to N \cup \{0\}$ such that each edge has an induced label

$$\omega(f,\ R(G)) = \{|f(u) - f(v)| : u,\ v \in R(G)\}$$

and the resulting edge labels are distinct. In this paper, we introduce a new type of graph labeling for a graph $G = (R, S)$ which we call G-graceful labeling. The G-graceful labeling for the graph $G = (R, S)$ with r vertices and $s$edges is an injective function $\rho : R(G) \to \{0, 1, 2, 3, \ldots, t-1\}$such that the induced function $\rho^* : S(G) \to N$ is given by$\rho^*(r, s) = \{\rho^*(r) + \rho^*(s)\}$,the resulting edge label are distinct. In this paper, we also prove that the graphs: path, ladder graph, flower graph, complete bipartite graph and star graph admit G-graceful labeling.

1. INTRODUCTION

In graph theory, there are two important parameters by which a graph $G = (R, S)$ can be represented abstractly and these are vertices and edges. Labeling of graph G means to give labels or weights to the vertices or edges or both

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A Genetic Algorithm Approach for Multi-Objective Transportation Problem with Hexagonal Fuzzy Number

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ABSTRACT

Several fuzzy approaches have been used for finding the compromise results in the context of "multi-objective transportation problem (MOTP)" with fuzzy parameters. In this work, we have examined a MOTP with "hexagonal fuzzy numbers (HFNs)" as its parameters, i.e., demand, supply and penalties of the problem are mold in HFNs with a new approach developed with the help of a genetic algorithm. Robust ranking is used for the defuzzified value of the hexagonal fuzzy parameters. We have found the BFS (basic feasible solution) of the problem by adopting the zero-point technique. Then the genetic algorithm is used for obtaining the compromising superlative solution by the set of feasible solutions obtained by the zero-point technique of the problem. An algorithm has been developed for the procedure. To figure out the adaptability of the proposed technique, a numerical example has been used.

1. Introduction

Transportation problems (TPs) is a kind of the optimization techniques, plays a crucial role in supply chain management to minimize total cost and for making the best service. Because of high competition in the market, it became too difficult to find the best system or way for distributing the product to the costumers at minimum cost or maximum profit by satisfying the demand of the costumers. Transportation problems TPs gave the best way to meet this challenge. The TPs are special kind of the linear programming problem. Because of its special structure, it is not comfortable to find the solution of this

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MEDIATIVE FUZZY LOGIC OF SUGENO-TSK MODEL FOR THE DIAGNOSIS OF DIABETES

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Abstract. Fuzzy Logic (FL) is very beneficial in medical field. But due to the consideration of membership function only; it cannot give an appropriate result in prese nt era of contradiction. So, we need to consider favourable as well as unfavourable cases together as the Intuitionistic Fuzzy Logic (IFL) does. But what happens if we have imperfect information that cannot be dealt with the IFL. When there-exist a contradiction in the expert knowledge, then we have to propose a Mediative Fuzzy Logic (MFL) based Sugeno's inference system for the diagnosis of diabetes. In the present research paper, we have proposed a new approach to the diagnosis of diabetes, we have collected certain information from Pima Indians Diabetes Database (PIDD) as input variables and we used MFL based inference system for the diagnosis of diabetes.

1. Introduction

Diabetes mellitus or simply diabetes is a major health issue that causes high level blood sugar. Its prevalence has been rapidly increasing in low- and middle-income countries; diabetes causes kidney failure, stroke, blindness, heart attacks and many more. When a doctor fails to correct diagnosis of diabetic patient then it may harmful to the patient.Diabetes mellitus or simply diabetes is a major health issue that causes high level blood sugar. Its prevalence has been rapidly increasing in low- and middle-income countries; diabetes causes kidney failure, stroke, blindness, heart attacks and many more. When a doctor fails to correct diagnosis of diabetic patient then it may harmful to the patient.Firstly, fuzzy set were introduced by professor L.A. Zadeh [1] in 1965 by using membership functions only. For a given universal set X and $A \subseteq X$, describe a set by using membership function $\mu_A(x) : X \to [0, 1]$, which takes value from closed interval of unit length. The possibility of an object 'x' belongs to the fuzzy set A varying between [0, 1] we may say that FL was used to handle partial truth value, which is not completely true or completely false. On the behalf of this theory, Zadeh described that fuzzy set theory is nothing but an extension of classical set theory. Fuzzy set have many real life and practical applications, it has been used to many areas from controlling system to Artificial Intelligence (AI). Later on, both concepts, classical logic as well as FL extended to IFL. IFL deals with two functions, membership and non-membership function and their values lies between closed unit interval [0, 1]and sum of these two values also lies in the same unit interval. IFL is generalization of FL; IFL helps to represent impartial knowledge and used to present many real-world problems in more appropriate manner. In 1986, K. Atanassov [2, 3] provide concept of IFL and used

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Mediative fuzzy logic mathematical model: A contradictory management prediction in COVID-19 pandemic

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Valuation method

ABSTRACT

This paper presents a model based on mediative fuzzy logic in this COVID-19 pandemic. COVID-19 (novel coronavirus respiratory disease) has become a pandemic now and the whole world has been affected by this disease. Different methodologies and many prediction techniques based on various models have been developed so far. In the present article, we have developed a mediative fuzzy correlation technique based on the parameters for COVID-19 patients from different parts of India. The proposed mediative fuzzy correlation technique provides the relation between the increments of COVID-19 positive patients in terms of the passage of increment with respect to time. The peaks of infected cases in connection with the other condition are estimated from the available data. The mediative fuzzy logic mathematical model can be utilized to find a good fit or a contradictory model for any pandemic model. The proposed approach to the prediction in COVID-19 based on mediative fuzzy logic has produced promising results for the continuous contradictory prediction in India.

1. Introduction

There are various mathematical aspects of the modelling and analysis of the expansion of infection and bacteria, or both types of disease in human beings. The mathematical models give important information about various parameters and their effects on different modes. These models help us in the estimation of the parameters and the evaluation of their sensitivity. But these traditional modelling and mathematical analysis are insufficient in the case of infections which are caused due to different strains of the virus. Coronavirus disease 2019 or simply COVID-19 is an infectious disease caused by SARS-CoV-2 i.e., severe acute respiratory syndrome coronavirus 2. In Wuhan, a city of China, the very first case was identified during December 2019. Now it has been spreading worldwide very quickly. COVID-19 took only a few days to expand from a city (Wuhan) to various parts of the rest of the World. The spreading rate of COVID-19 is too high, which includes imported cases in travellers, transmitted cases of "no-mask", cases of close contacts of two or more known infected persons. The shortfall of PPE (personal protective equipment) and ventilators have been increasing the stress rate on healthcare management systems. [1] shows that approximately 200 countries and millions of infections and three lacs death as it has escalated into a global pandemic.

Normal fever, cough, breathing shortness, loss of smelling, loss of taste and fatigue are the most common symptoms of COVID-19. And the symptoms take around one to fourteen days converts into the dangerous virus. According to the "European Centre for Disease Prevention and Control" [2] one person out of five infected persons do not develop any kind of symptoms Many studies have been conducted for the analysis of COVID-19 and coronavirus so far [3–5] & [6]. The epidemiology group of new coronaviruses(Pneumonia Emergency Response Mechanism of Chinese Centre for Disease Control and Prevention 2020) [7] gave an article on the COVID-19 epidemic. A study [8] shows that to prevent the spread of COVID-19 infection, an interval intervention is being used [9] provided an update on coronavirus infections and relevant diseases, and he describes the role of the natural immune system in the pathogenesis and medical treatment. In the sanitary area of Lugo, a study [10] was also conducted of patients with a COVID-19 diagnosis with telemedicine and telemonitoring. Clinical interview and measure of self-report questionnaires for prediction were also used [11] to study the depression, post-traumatic stress disorder, insomnia, taking anxiety, obsessive–compulsive symptoms, phobia, paranoid personality styles for the study of COVID-19 patients. A fuzzy expert system technique [12] has also been introduced to the identification and prevention of COVID-19 patients.

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Mediative fuzzy logic mathematical model: A contradictory management prediction in COVID-19 pandemic

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ABSTRACT

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1. Introduction

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An Alternate Cost-effective Medium for In Vitro Regeneration of Therapeutically Important *Ocimum citriodorum* Vis.

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A novel cost-effective in vitro regeneration protocol has been evolved for the therapeutically important Ocimum citriodorum Vis. In the present study, table sugar (3%) and isabgol (Psyllium husk) (3.5%) were used as an alternate source of carbon and gelling agent respectively in Murashige and Skoog's (MS) medium. The explant used in the current study was nodal segment. A significant observation revealed that all the cultures resulted in shoot induction and maximum number of shoots/ culture (6.04) and their average length (2.15 cm) was obtained on modified MS-medium supplemented with table sugar, isabgol and BAP. However, best root induction (95.83%) was obtained on ½ MS-medium augmented with table sugar (3%) , isabgol (3.5%) and NAA. An increase in average number of roots per shoot (6.91%) as well as average root length (2.73 cm) was also observed in the same modified medium. The in vitro regenerated plantlets were successfully transferred to the field and no notable variation was observed in their morphology. The overall cost of culture medium for in vitro propagation of O. citriodorum Vis. was reduced significantly by 92.69% when agar and sucrose were replaced by isabgol and table sugar, respectively.

Keywords: Cost-effective medium; Isabgol; Ocimum plants; Regeneration; Table sugar.

Ocimum citriodorum Vis. (Lemon basil) is an important medicinal plant, abundant in volatile aromatic essential oils and is known to possess culinary properties[1,2]. It is an interspecific hybrid obtained between *Ocimum basilicum* and *O. americanum*. This herb is mainly cultivated in some parts of Asia and Africa not only for its essence but also as an important source of antioxidants. It is one of the most economically important spice used for flavor in many cuisines[3]. Due to its medicinal value, it has been used as anti-inflammatory agent[4] and to treat people suffering from premature ejaculation, delayed menstruation cycle and stomach spasms[5]. The oil of *Ocimum* is valued for its therapeutic properties and possess antimicrobial, nematocidal, fungistatic and insecticidal activities[6, 7]. The essential oils of *Ocimum* species have been reported to elicit a greater escape response against

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Threat and sustainable technological solution for antineoplastic drugs pollution: Review on a persisting global issue

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What do these dates mean?

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ORIGINAL RESEARCH ARTICLE

In Vitro Cytotoxicity Study of Cyclophosphamide, Etoposide and Paclitaxel on Monocyte Macrophage Cell Line Raw 264.7

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Received: 6 March 2020 / Accepted: 11 June 2020 / Published online: 18 June 2020

Abstract The presence of antineoplastic compounds in aquatic ecosystem is an emerging challenge for the society. Antineoplastic compounds released into the aquatic environment exhibit a potential threat to normal aquatic life. Particularly, antineoplastic compounds are responsible for direct or indirect interference with the cellular DNA of an organism and cause toxicity to cells. The present study focused on the assessment of in vitro toxic effect of cyclophosphamide, etoposide and paclitaxel on Raw 264.7 cell line (mouse monocyte macrophage cells). The inhibitory concentration of cyclophosphamide, etoposide, and paclitaxel was determined. The IC_{50} values of these compounds were 145.44, 5.40, and 69.76 μg ml^{-1} respectively. This is the first report on toxicity analysis of cyclophosphamide, paclitaxel and etoposide on Raw 264.7 cell line by reducing cell viability and indicating the cell cytotoxicity i.e., 69.58% for cyclophosphamide, 92.01% for etoposide and 88.85% for paclitaxel on concentration 250 μg ml^{-1}. The results of their cytotoxicity assessment highlight the need of improvement in sewage treatment technology for the efficient removal of these compounds from aquatic environment.

Keywords Anticancer compounds · Cell culture · Immune cells · Toxicity · Cell viability

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Introduction

Worldwide, cancer is the second highest non-communicable disease after cardiovascular disease. The incidence of new cancer cases in year 2012 was 14.1 million and it becomes increases to 18.07 million in the year 2018 [1]. Consequently, this increment in cancer incidence leads to the demand, production and consumption of antineoplastic drugs [2–4]. Unexpectedly, through the oncology wards of hospitals, discharge of hospitalized patients, outpatients and due to lack of treatment facility in STPs (sewage treatment plant), antineoplastic compounds are persistently coming into water bodies. Several studies investigated the presence of these compounds in aquatic the environment and the occurrence is due to persistence or recalcitrant nature of antineoplastic drugs after going through treatment plants and remain dynamic after pass through wastewater treatment plant [5–11]. Antineoplastic drugs are non-specific in nature and have a property to kill or inhibit cell growth by blocking the cell cycle. So, due to their lack of specificity and negative interaction with cellular DNA, they are cytostatic and mutagenic for normal cells even present at very low concentrations in water bodies [12].

Researchers reported the toxicity (cytotoxicity, mutagenicity, and ecotoxicity) of antineoplastic compounds on different models in terms of EC_{50} (effective concentration), LC_{50} (median lethal dose), IC_{50} (inhibitory concentration), LOEC (Lowest observed effect concentration), and NOEC (No observed effect concentration) [13–17]. But the effect of cyclophosphamide, etoposide and paclitaxel on the immune system of any organism is not elucidated yet. Every organism has a defence mechanism against pathogens and other toxic substances [18, 19]. The immune system has different specialized cells which protect the body from harmful substance. Among these cells, the

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RESEARCH ARTICLE

Metal accumulation and health risk assessment in wastewater used for irrigation around the Agra Canal in Faridabad, India

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Abstract

Wastewater application for irrigation is a traditional and economic tool in developing nations. Yet prolonged use of wastewater for agricultural activities contributes to the accumulation of metals in both soil and vegetables. This study investigated the accumulation and contamination of vegetables with heavy metals ensuing from the application of wastewater from the Agra Canal and the associated risks posed to human health. Three sites across the Agra canal were selected for sampling (CW-1, CW-2, and CW-3), where untreated wastewater is being used to irrigate vegetables (spinach, coriander, radish, and garlic crops), for which tube-well water (TW) from a village served as the control site. Water, soil, and vegetable samples were collected from all sites. The presence in them of various metals, such as As, Pb, Cr, Mn, Cu, Zn, and Ni, was detected at all four sites. The greatest content of Mn was found in CW-1's water (7.91 mg/L), soil (633.77 mg/kg), and in spinach 368.12 (mg/kg) grown there. Significantly higher metal concentrations were observed in vegetables irrigated with wastewater than in tube-well-irrigated vegetables, with the metals ranked in accumulation as follows Mn > Zn > Ni > Cu > Cr > Pb > As. Our results also revealed that metal bioaccumulation varied enormously between foliar and non-foliar vegetables, as well as among the four sites. Daily metal intake (DMI) and health risk index (HRI) analyses suggested that children consuming contaminated vegetables are at higher risk than adults. The HRI for Mn, Ni, and Pb was above 1, which indicated significant health hazards to humans consuming the wastewater-irrigated vegetables. Moreover, the control site where tube-well water was used had an HRI below 1, signifying a negligible health risk for its consumption. Therefore, we may conclude that the extensive application of contaminated water for a longer duration would likely further increase metal accumulation in soil and vegetables that may be hazardous to living organisms.

Keywords Bioconcentration · Canal water · Daily intake of metals · Environmental pollutants · Health hazard · Irrigation

Introduction

Water is the paramount resource for sustaining life on earth. Clean water is one of the Sustainable Development Goals adopted by United Nations Development Programme. Rapidly increasing industrialization and urbanization have led to more wastewater being generated, this often used as an economic substitute for conventional irrigation water. Over 80% of the world's wastewater, and up to 95% of it in some of the world's least developed countries, is discharged directly into the environment in an untreated form (WWAP (United Nations World Water Assessment Programme) 2017).

Due to water scarcity around the world 15 million m^3/day of untreated wastewater is used for crop irrigation; this applied to 11% of the world's total agricultural land. About 10% of the world's population consumes crops and vegetables that are grown with the use of untreated wastewater (Shahid et al. 2020; Ungureanu et al. 2020). Globally, agricultural activities are estimated to use roughly 70% of the planet's available freshwater (Guadie et al. 2020). Although India has only 4% of this key water resource, it is home to 16% of the world's population. The country's total utilizable water supply is estimated to be 1123 billion cubic meters (BCM), of which only 28% is derived from precipitation. Irrigation accounts for around 85% (688 BCM) of total water use in India (Kaur et al. 2012). Given the lack of freshwater, wastewater usage

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Silver based hybrid nanocomposite: A novel antibacterial material for water cleansing

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What do these dates mean?

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Facile green synthesis of ZnO–$CdWO_4$ nanoparticles and their potential as adsorbents to remove organic dye☆

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ABSTRACT

In this work, ZnO–$CdWO_4$ nanoparticles have been synthesized by the ecofriendly green method with lemon leaf extract to favorably anchor functional groups on their surface. The prepared ZnO–$CdWO_4$ nanoparticles are used as adsorbent to treat Congo red (CR) dye after characterization through FT-IR, UV–Vis, TEM, SEM-EDX, and HRTEM techniques. The equilibrium partition coefficient and adsorption capacity values for CR by ZnO–$CdWO_4$ are estimated as 21.4 mg g^{-1} μM^{-1} and 5 mg g^{-1}, respectively (at an initial dye concentration of 10 mg L^{-1}). The adsorption process is found as exothermic and spontaneous, as determined by the ΔG°, ΔS°, and ΔH° values. The Boyd plot has been used as a confirmatory tool to fit the adsorption kinetics data along with intraparticle diffusion and pseudo-second-order models. Based on this research, ZnO–$CdWO_4$ nanoparticles are validated as an effective adsorbent for CR dye in aqueous solutions.

1. Introduction

Although water is an essential component of our life, its contamination takes place continuously by various anthropogenic activities (Gogoi et al., 2019). The accumulation of contaminants in aquatic systems has been posing adverse risks to human health in various respects (Nehra et al., 2019). Like many other contaminants in wastewater, dye components are produced from various sources such as textile, food, pharmaceutical, paper, and cosmetic industries. To treat such contaminants, a myriad of physical, chemical, and biological methods have been developed and adopted such as filtration, coagulation, flocculation, ion exchange, Fenton reagent, photocatalytic processes, adsorption, and aerobic/anaerobic degradation (Kandisa et al., 2016). Knowing that most of these treatment methods require high capital and operational cost, adsorption is often selected as a favorable treatment option in a practical sense (Jua et al., 2020; Xiang et al., 2019, 2020; Sirajudheen et al., 2020).

Organic dyes with a carcinogenic nature belong to one of the most well-known water pollutants (Teodosiu et al., 2018). The presence of dyes results in the formation of colored layers on the surfaces of water bodies to prevent the permeation of sunlight into the bulk water and to ultimately damage aquatic ecosystems (Vikrant et al., 2018). Among various dyes, Congo red (CR), a benzidine-based dye, is one of the most dangerous contaminants, as demonstrated by its acute oral toxicity in rats (Auterhoff, 1969). The lowest intravenous lethal dose (LD_{Lo}) value of CR was found as 1.43 mg kg^{-1} for humans (Wochenschrift, 1964) and 160 mg kg^{-1} for rats (Richardson and Dillon, 1939). Benzidine-based dyes were reported to cause hepatocarcinoma, splenic sarcoma, and nuclear anomalies in experimental animalss (Sarkar et al., 2017). The toxicity effects of CR have also been observed from diverse living forms including humans (e.g., vomiting, diarrhoea, and nausea) (Gupta et al., 2020). As one of its metabolic products, benzidine has also been identified as a bladder carcinogen (Frid et al., 2007). Among many metal oxide semiconductors, zinc oxide (ZnO) has gained widespread attention because of its excellent properties (e.g., high physical/chemical stability, low cost, ease of preparation,

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Exploring the Relationship Between Social Ties and Resilience From Evolutionary Framework

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This conceptual paper examines the necessity and importance of social bonds and networks in building resilience to fight the COVID-19. Resilience is a quality that energizes an individual's actions and acts as a buffer to stressful events. The current article is intended to explore the evolutionary programmed behavior of the human mind to make social ties and structure. Humans have a strong need to connect and relate with other individuals by developing cooperation and perspective-taking. The ability to make social connections, group living, and sharing resources had a selective advantage in coping with physical and psychological stress. Social bonds provide resilience to people's approach while making adjustments and adapting to situations, thus presents fitness benefits at both group and individual levels. An attempt has also been made to address how social isolation as a strategy to contain the infection adversely influence body homeostasis. Finally, this article recommends health practitioners, clinicians, and researchers to encourage research on the impact of social isolation/social interaction on mental and physical health indicators.

Keywords: social connections, COVID-19, stress, resilience, evolutionary process

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INTRODUCTION

The end of 2019 and the beginning of 2020 were marked by a worldwide outbreak of the COVID-19 pandemic. Coronavirus infection spread amongst the human population through droplet infections, contacting contaminated surfaces, and aerosols. The most effective strategy to contain the spread of the virus is to break the chain through social distancing, quarantine, hand hygiene, and wearing the mask (Saltzman et al., 2020). The nation-wise lockdown was imposed in various countries to contain the spread of coronavirus in March–April 2020. This global event has been tremendous in scale, with a far-reaching and profound impact on physical, psychological, social, economic, educational, and health systems across countries. The pandemic has shaken the world upside down with its nature and long-lasting effects, making us reflect on the integral and innate aspects of life. These aspects help us to survive, adjust, and function better in everyday situations. Social bonds and networks are one of those whose importance got highlighted. We acknowledge the significance of isolation during the pandemic. At the same time, there is a need to differentiate isolation without social interactions (as it happens in hospitals) and isolation at home (where an individual has interactional access with significant ones while following social distancing). In this article, we argue that isolation without social interactions may present short- and long-term undesirable effects on psychological and physical health. It is quite evident from the recommendation for home isolation given by several experts and governments (Mariani et al., 2020). In home isolation, the patient is not deprived of

atoms

MDPI

Article

Extended Atomic Structure Calculations for W^{11+} and W^{13+}

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Abstract: We report an extensive and elaborate theoretical study of atomic properties for Pm-like and Eu-like Tungsten using Flexible Atomic Code (FAC). Excitation energies for 304 and 500 fine structure levels are presented respectively, for W^{11+} and W^{13+}. Properties of the 4*f*-core-excited states are evaluated. Different sets of configurations are used and the discrepancies in identifications of the ground level are discussed. We evaluate transition wavelength, transition probability, oscillator strength, and collisional excitation cross section for various transitions. Comparisons are made between our calculated values and previously available results, and good agreement has been achieved. We have predicted some new energy levels and transition data where no other experimental or theoretical results are available. The present set of results should be useful in line identification and interpretation of spectra as well as in modelling of fusion plasmas.

Keywords: oscillator strength; FAC; NIST; EBIT; spectroscopy

PACS: 32.70; Cs oscillator strengths

1. Introduction

There has been strong interest in the spectroscopy of tungsten as it is planned to be used in plasma facing components of future fusion devices, such as International Thermonuclear Experimental Reactor (ITER) due to its favourable physical and chemical properties, e.g., high energy threshold of sputtering, low sputtering yield, low tritium retention, and high melting temperature [1,2]. Since tungsten is a high-*Z* element ($Z = 74$), where Z is the atomic number, it will contribute a large fraction of energy carried out from the plasma, which leads to plasma cooling. Atomic data such as energy levels, radiative transition rates, and photoionization cross sections for low-charged and medium-charged ions are of great importance in the ITER plasma diagnostics [3]. In the past few decades, atomic data for several highly charged tungsten ions have been determined using different experimental and theoretical methods [4–8], but still there is demand for more accurate atomic data, especially for low and medium ionization states of tungsten.

In the present work, spectra of moderately charged states of tungsten (W^{11+} and W^{13+}) are theoretically investigated. Several observations and theoretical calculations have been performed for Pm-like W but, for Eu-like W, only a few experimental data are available in the literature. In fact, only one theoretical energy value can be found for Eu-like W in the Atomic Spectra Database of the National Institute of Standards and Technology (NIST) [9]. These ionized states of tungsten are complex due to an open 4f shell, and obtaining accurate atomic data for these ions is a largely unsolved problem. For example, by inclusion of different configuration sets in the calculations, one will obtain a different ground state. The accuracy of a calculation can be estimated by considering (i) the convergence rate, (ii) the agreement between experimental measurements and theoretical calculations, and (iii) the

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Energy levels, transition data and collisional excitation cross-section of Sn^{3+} and Sn^{4+} ions

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ABSTRACT

We have calculated atomic data such as energy levels, transition wavelengths, oscillator strengths, transition rates, lifetimes and Collision cross-section for Sn^{3+} and Sn^{4+} ions. We have employed Flexible atomic code (FAC) in our computations. We have computed lowest 31 and 17 fin. structure levels for Sn^{3+} and Sn^{4+} resp. We have provided transition data for all electric dipole (E1), magnetic dipole (M1), electric quadrupole (E2) and magnetic quadrupole (M2) transitions among lowest 31 levels and 17 levels for Ag-like Sn and Pd-like Sn resp. We have also reported collision cross-section for Ag-like and Pd-like Sn from ground state to lowest 31 levels and 17 levels resp. We have compared our calculated data with available theoretical and experimental results and discussed difference between them. Extremely large lifetime of $4d^95$ s levels of Sn^{4+} ion is predicted in this work.

1. Introduction

The light emitted from neutral Sn to Sn^{4+} ions exist in plenteous amount in various types of plasmas such as laser produced plasma, discharge plasma, fusion and astrophysical plasma etc. [1–15]. The spectroscopic investigation of Sn^{3+} and Sn^{4+} ions is very crucial as it helps in modeling of plasma and characterization of plasma parameters [16–22]. Recently, the development of highly efficient X-ray lasers has opened the doors for identification of spectral lines from the spectra of Ag-like and Pd-like Sn ions. But on theoretical side, there is very fewer amounts of data are available in literature.

Early in 1970, Carlson et al. [23] have calculated approximate solution of ionization potential of elements from nuclear charge 2–103. Joshi et al. [24] experimentally measured three resonance lines of $4d^{10}$ to $4d^95p$ of Sn V. S. M. Younger [25] has presented line strength of transitions $4d^{10}\ ^1S - 4d^94f\ ^1P^\circ$ for Pd-like ions under three approximations configuration-averaged Hartree Fock, term-dependent Hartree-Fock and many-body perturbation theory. Sugar et al. [26] have identified resonance lines of $4d^94f$ and $4d^95p$ from Pd-like Nd to Pd-like Ho and Pd-like Xe. Migdalek et al. [27] have reported first ionization potentials Ag-like Sn and other ions by employing relativistic Hartree-Fock method. They have studied the core polarization on ionization potentials of Cu, Ag and Au ions. Pinnington et al. [28] have determined lifetimes of 6 s ^2S, 5p ^2P, 6p ^2P, 5d ^2D, 6d ^2D, $4d^95\ s^2\ ^2D$, $4d^94f^2\ ^2F$ levels of Sn IV by using beam-foil intensity curves. Dunne et al. [29] have studied EUV spectra of Ag-like Sn, Sb and Te using laser produced plasmas and reported intensity, wavelength, transition rates and weighted oscillator strengths of lines $4d^{10}5\ s - 4d^95\ s5p$. Churilov et al. [30] have determined wavelengths, intensity and weighted transition rates of $4d^{10}$ - $4d^9$ (np + nf) $J = 1$ transitions of Pd-like Sn and other Pd-like ions experimentally. E. P. Ivanova [31] has reported energies, collision cross-sections, transition probabilities, transition wavelengths of Pd-like ions for Z = 50–63 by employing relativistic many body perturbation theory with model potential. He [32] has also presented transition data of spectral lines 5 s-5p, 5p-5d, 4f-5d, and 5d-5f for Ag-like ions from nuclear charge 50–86. Safronova et al. [33,34] have computed excitation energies and radiative data of some few levels of Ag-like and Pd-like ions by utilizing relativistic many body perturbation theory. Ryabtsev et al. [35] have studied spectrum of Pd-like Sn and measured excitation energies of $4d^97s$, $4d^96p$, $4d^96d$ and $4d^85\ s5p$ and also measured radiative data between these levels. They have also measured autoionizing widths of $4d^95p^2$, 4d5 s6p, $4d^95$ snf (upto n = 9) for Ag-like Sn [36]. They have also studied the spectra of $4d^{10}5p - 4d^95p^2$ transition for Ag-like In, Sn, Sb and Te ions experimentally [37]. S. Djenize [38] have observed the impact of He I and He II metastable states in Sn II, Sn III and Sn IV ionization and population processes. Glowacki et al. [39] have computed only two ns-np transitions for Ag-like Cd, In, Sn, Sb, Te, I, Xe, Cs, Ba and La and Au-like Hg, Tl, Pb, Bi ions by using configuration interaction method. Yu et al. [40] have calculated transition energies of two transitions $4d^{10}5\ s\ J = 1/2 - 4d^{10}5p\ J = 1/2$ and $4d^{10}\ J = 0 - 4d^95p\ J = 1/2$ for Ag-like Sn and Pd-like Sn respectively and also presented data of other ions with the help

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Equation of state of PNJL model under the influence of thermal mass and magnetic field

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Abstract. We present analytical results of the equation of state (EOS) described by a model of thermal quark mass and magnetic potential term introduced in Polyakov–Nambu–Jona–Lasinio (PNJL) model for two-flavour quarks. Under the influence of thermal quark mass and magnetic field term in the potential, the calculated results of EOS using the model are enhanced in a good pattern up to the temperature $T = 2.2T_c$ MeV and can follow result similar to the unmagnetised field when the temperature is increased beyond $T = 2.2T_c$ MeV. The result shows that the thermodynamic behaviour agrees well with the standard properties of quantum chromodynamics (QCD) thermodynamics and enhance the result up to $2.2T_c$ from the earlier predicted results and show the same behaviour beyond $2.2T_c$ MeV.

Keywords. Quantum chromodynamics; quark-gluon plasma.

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1. Introduction

Quantum chromodynamics (QCD) describes the theory of strong interactions at non-zero density and at very high temperature. Two of the striking features of QCD are the spontaneous symmetry breaking of chiral symmetry and deconfinement. Both have non-perturbative origin. The interactions among quarks get weaker with distance, and this feature is known as asymptotic freedom [1]. Moreover, the interaction becomes stronger as the particle separation increases, which is found in the case of hadrons. A quantitative understanding of this mechanism, called confinement, is hard, even though we know the underlying theory. Due to the non-Abelian nature of QCD, an additional gluon self-interaction term is created by colour interaction of gluons. It is very difficult to solve the QCD equations on a purely mathematical ground [2]. We can use the perturbation theory at short distance due to the asymptotic property of QCD, which is to solve QCD in the strong coupling regime, relevant to nuclear physics. It can be done through numerical calculations of QCD on a discrete four-dimensional space–time lattice quantum chromodynamics (LQCD) [3]. So, deconfinement in a gauge theory is really due to spontaneous symmetry breaking of global centre symmetry. The Polyakov loop constitutes an order parameter for the centre symmetry [4]. So, basically the definition of deconfinement is nothing but a phase transition from colourless bound states to colour unbound states, i.e., from bound hadrons to unbound quarks and gluons in QCD or from glueballs to unbound gluons in pure gauge theory [5] where the issue of symmetry breaking to the restoration of chiral symmetry breaking happened. Therefore, due to the release of degrees of freedom, we expect a sharp transition from a confined hadronic phase to a deconfined phase of non-interacting colour quarks and gluons. Thus, the presence of dynamical quarks in QCD explicitly breaks the centre symmetry. Nevertheless, the Polyakov loop remains small up to a certain temperature and then increases rapidly in a very narrow temperature interval, which coincides with the rapid increase of the energy density, indicating a sudden change in the number of degrees of freedom from bound to unbound colour matter. In addition to these ideas, if we consider the entangled Polyakov–Nambu–Jona–Lasinio (PNJL) model with a Polyakov loop scale parameter that depends on the magnetic field, it is possible to obtain an earlier rise of the Polyakov loop with the increase of the magnetic field. The entanglement brings inverse magnetic catalysis in the lattice QCD calculations [6]. The NJL-type models and LQCD calculations indicate the signal for enhance-

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Determination of atomic properties in the oxygen isoelectronic sequence

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ABSTRACT

Atomic data including energy levels, excitation energies, line strengths, transition probabilities, and weighed oscillator strengths for $2s^22p^4$, $2s2p^5$ and $2p^6$ levels are evaluated for O-like ions (Kr, Rb, Sr, Y, Nb, Zr, Mo, La, Ce) by using Multiconfiguration Dirac-Hartree-Fock (MCDHF) approach. Valence and core-valence correlation effects were accounted for through single-double multireference (SD − MR) expansions to increasing sets of active orbitals. To confirm the accuracy of present results, independent calculations have been performed by using fully relativistic Flexible Atomic Code (FAC). Comparisons are made between our two different set of results, as well as with the other available experiments measurements and theoretical calculations. The present data are accurate enough for identification and are also useful for modeling and diagnosis fusion plasmas. We have reported many new atomic data which is not available in the literature and we believe our presented data can be considered as a benchmark of other calculations.

Introduction

Accurate atomic data for highly charged ions have become a subject of interest not only for atomic Physics but also for plasma physics, astrophysics and fusion physics. In astrophysics, soft X-ray and Extreme Ultraviolet (EUV) transition lines from highly charged ions can bring valuable insight in the understanding of astrophysics spectra because they provide knowledge of Stellar and solar coronae. Also, forbidden transitions are useful for understanding astronomical spectra. Oxygen like ions are prominent in the spectra of hot stellar coronae and in supernova remnants [1,2] and therefore are of considerable interest for the modeling of astrophysical and laboratory plasma. Further, the transition lines belonging to $2p^4$ configuration are important as they are present in solar flares [3] and tokomaks [4]. Since for nuclear charge greater than 30, relativistic effects on radial functions become important and a fully relativistic treatment based on the Dirac equation is required, therefore in present work, we have used MCDHF method for calculation of atomic parameters.

Atomic parameters such as transition wavelength, transition probability, oscillator strength, photoionization cross section etc. within $2p^4$ configuration of oxygen isoelectronic sequence have been the subject of attention during last few decades. Most of the work reported in the past in oxygen isoelectronic sequence was for $Z \leq 36$. Viktorov and Safronova [5] calculated transition energies and probabilities for oxygen isoelectronic sequence (Z = 8–100) in the intermediate coupling scheme. Behring et al. [6] observed 2 s-2p transition in the range 30 to 73 Å for O-like Y and Nb. After few years, similar identification for 2s-2p transition lines for oxygen like Mo was performed by Feldman et al. [7]. Chandler et al. [8] reported X-ray transitions between $2s^22p^33p$ excited levels and $2s2p^5$ lower level of oxygen like Lanthanum. Chen and Crasemann [9] calculated energies and oscillator strength for electric dipole transitions for oxygen isoelectronic sequence within $10 \leq Z \leq 79$ using the multi configuration Dirac-Fock method. Zhang and Sampson [10] calculated relativistic distorted wave collision strengths for O-like ions with $14 \leq Z \leq 92$. Hao et al. [11] calculated transition wavelengths, transition probabilities, absorption oscillator strengths and line strengths for Kα and kβ transitions of He-like to Ne-like Mo ions using GRASP and GRASPUV code. Aggarwal et al. [12] also used GRASP code to energy levels, oscillator strengths, line strengths and lifetimes for B-like to F-like Kr ions. Zhang et al. [13] calculated the transitions wavelengths, electric dipole transition probabilities, line strengths and absorption oscillator strength for Kα X-rays for Kr XXVII to Kr XXXV using multi configuration Dirac-Fock (MCDF) and relativistic configuration interaction (RCI) methods. Hu et el. [14] calculated forbidden transition probabilities for $2p^4$ configuration of O-like sequence for $8 \leq Z \leq 42$. They included Breit interaction, quantum electrodynamics and finite nuclear mass corrections in extended optimal level scheme using multi configuration Dirac-fock wave functions. Rynkun et al. [15] using multiconfiguration Dirac-Hartree-Fock method evaluated E1, E2, M1, M2 transitions rates, weighted oscillator strength and lifetimes for

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ARTICLE

Partition function and thermodynamic quantities with atomic data of Ag XLIV

Ravinder Kumar, Narendra Singh, and Arun Goyal

Abstract: In this work, the atomic parameters of Ag XLIV (Be-like Ag) are examined and evaluated by implementing the GRASP2K package with the multi-configuration Dirac–Hartree–Fock (MCDHF) method for the calculation of wave-functions. We have listed fine structure energy levels of the lowest 170 levels with radiative data for multipole moments, such as electric dipole (E1), electric quadrupole (E2), magnetic dipole (M1), and magnetic quadrupole (M2) transitions, that lie in the region of extreme ultraviolet (EUV) and soft X-ray (SXR) for Ag XLIV from the ground state within the lowest 170 levels. We have compared our GRASP2K and FAC results with theoretical results available in the literature for some levels. Additionally, we have also calculated partition function and thermodynamic quantities for temperature ranges from 10^4 to 10^7 K. We believe that our presented details and data may be beneficial not only in plasma modeling but also in imaging of nanostructure as well as in medicine, semiconductors, and EUV and SXR laser applications.

Key words: energy levels, radiative data, spectroscopic parameters, transition wavelength, thermodynamic quantities, partition function.

Résumé : Nous examinons et évaluons ici les paramètres atomiques du Ag XLIV (Ag de type Be), en adoptant l'ensemble logiciel GRASP2K avec la méthode de Dirac–Hartree–Fock multi-configurations afin de calculer les fonctions d'onde. Nous proposons la liste des niveaux d'énergie de structure fine des 170 niveaux les plus bas, avec des données radiatives pour divers moments multipolaires, le dipôle électrique (E21), le quadripôle électrique (E2), le dipôle magnétique (M1) et le quadripôle magnétique (M2), qui se trouvent sous l'UV extrême (UVE/EUV) et les rayons X mous (RXM/SXR) pour Ag XLIV du fondamental à l'intérieur des 170 niveaux les plus bas. Nous comparons nos résultats avec des résultats retrouvés dans la littérature pour certains niveaux. De plus, nous calculons la fonction de partition et les quantités thermodynamiques pour des températures allant de 10^4 à 10^7 K. Nous croyons que nos détails et résultats présentés ici peuvent être utiles, non seulement pour la modélisation des plasmas, mais aussi pour l'imagerie de nanostructures aussi bien que pour des applications en médecine, en semi-conducteurs et en lasers UV extrêmes et rayons X mous.

Mots-clés : niveaux d'énergie, données radiatives, paramètres spectroscopiques, longueurs d'onde de transition, quantités thermodynamiques, fonction de partition.

1. Introduction

Over the past few years, study of highly ionized ions has become important because of their potential applications in several types of plasmas and their modeling. The radiative data, excitation energies, collision and photoionization cross-sections, etc., are helpful in the study of fundamental parameters of plasma [1–3]. The effect of relativistic corrections, namely, QED and Breit in the energy levels of these ions opens the door for the analysis of the effects of these corrections in plasma diagnostics. Joint European Torus and tokamak reactors have already achieved electron temperatures from 5 to 10 keV, which shows the importance of highly ionized ions. Most of the radiative transitions within the lowest few levels in highly ionized ions lie in the regions of extreme ultraviolet (EUV) and X-rays, which are useful in study of plasma parameters. Therefore, radiative data within these ranges are studied here for Ag XLIV.

There are some theoretical results and experimental observations available in the literature on Be-like ions, including Be-like Ag, which have been carried out by applying several types of theoretical methods and experimental techniques [4–26]. The importance, applications, and prominence of Be-like ions can also be revealed from the fact that these ions are a topic of current research and interest for researchers as the four-electron system is the simplest system in which intra-shell and inter-shell interactions are significant, while two- and three-electron systems show intra-shell and inter-shell interactions, respectively. Malyshev et al. [27] have listed ionization energies of S XIII to Cm XCIII by using QED perturbation series. Verdebout et al. [28] have computed excitation energies, hyperfine interaction constants, and Lande factors for Be-like ions with the help of a relativistic interaction method. Naze et al. [29] have provided excitation energies and mass shifts using the perturbation method as well as relativistic configuration interaction. Feng Hu et al. [30] have studed correlation effects in nl–$n'l'$ transitions in nine silver isoelectronic sequences including B-like Ag. Sims et al. [31] have studied the ground state of Be-like ions by scaling orbital exponents with the Hylleras method of configuration interaction. Ionization energies for the ground state of S XIII to Cm XCIII by using perturbation theory have been provided by Malyshev et al. [32]. Kilin [33] has predicted error in the sequence of energy levels for Li- and Be-like ions for atomic numbers greater than 50 by making use of the Dirac–Hartree–Fock method. Sang et al. [34] have given energies, radiative, and non-radiative data of $1s2p^3$ for O V to Xe LI by using multi-configuration Dirac–Fock method.

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Earth and Space Science

RESEARCH ARTICLE
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Carbonaceous Aerosol Characterization and Their Relationship With Meteorological Parameters During Summer Monsoon and Winter Monsoon at an Industrial Region in Delhi, India

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Key Points:

- Study focuses on carbonaceous aerosol organic carbon (OC) and elemental carbon (EC) in PM10 at industrial region
- Average OC and EC levels were high in winter monsoon than the summer monsoon
- Meteorological variables played a significant role in levels distribution of OC and EC

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Abstract PM_{10} samples were collected and atmospheric organic carbon (OC) and elemental carbon (EC) were determined during summer monsoon (SM) and winter monsoon (WM) seasons in 2016–2017 at an industrial location in New Delhi, India. Owing to high combustion and emission activities in the industrial area, it was imperative to characterize the carbonaceous aerosols, including their morphology and seasonal distribution. The mean PM_{10} concentration was 144 ± 53.7 and 210.4 ± 50.7 μg/m^3 in SM and WM, respectively, with an overall average of 174.6 ± 64 μg/m^3. Moreover, the OC concentration was 70.3 ± 53.7 and 94.3 ± 40.3 μgC/m^3 during the SM and WM, respectively, with an overall average of 79.9 ± 44.9 μgC/m^3, and the EC concentration was 50.8 ± 53 and 62.6 ± 49.8 μgC/m^3, respectively, with an overall average of 58.3 ± 46.7 μgC/m^3. The morphological observations of collected particles were studied and the char/soot particles, iron-rich particles, and aggregates of calcium sulfate particles were observed during both the seasons. However, the predominance of combustion-derived particles such as soot and char was higher in the WM than in the SM. Further, the OC/EC ratio suggested the presence of mixed sources at the industrial location, predominated by industry and motor vehicle emissions. The relationship of carbonaceous aerosol with meteorological variables was also studied, and it was found that temperature, atmospheric stability, wind direction, and rain intensity significantly affect the levels of OC as compared to that of EC during both seasons.

1. Introduction

Particulate matter (PM) in the atmosphere, especially in metropolitan and highly industrialized regions, is a key parameter for identifying the severity of air pollution (Saxena & Sonwani, 2019; Seinfeld et al., 1998; Sonwani & Kulshrestha, 2016; Tiwari et al., 2014). The air pollution resulting from natural as well as anthropogenic aerosol comprises carbonaceous matter, dust, sulfates, nitrates, and fly ash (Ramanathan et al., 2005). Carbonaceous aerosol is one of the important components of PM and contributes about 20%–50% of PM with diameter <2.5 μm ($PM_{2.5}$; Kanakidou et al., 2005; Putaud et al., 2010). The presence of carbonaceous aerosol in PM attracts scientific attention due to its significance to climate, visibility, and human health (Dey & Tripathi, 2008; IPCC, 2001; Seinfeld & Pandis, 1998; Sonwani & Kulshrestha, 2019; Watson, 2002). Moreover, carbonaceous particles also play an important role in absorbing and scattering incoming solar radiations (Jacobson, 2001). Organic carbon (OC) and elemental carbon (EC) are the two major fractions of carbonaceous aerosol. OC consists of polycyclic aromatic hydrocarbon (PAHs), polychlorinated biphenyls (PCBs), and other compounds with potential mutagenic and carcinogenic effects and has both primary and secondary sources (Cao et al., 2003; Sarkar & Khillare, 2013; Sonwani, Amreen, & Khillare, 2016, Sonwani, Saxena, & Kulshrestha, 2016). Primary organic carbon (POC) originates in the combustion process and is released as an aerosol, while secondary organic carbon (SOC) is produced during the gas-to-particle transformation of volatile organic compounds in the atmosphere. SOC is produced either through condensation of volatile organic compounds (VOCs) or absorption of gaseous substances on particle surface (Pandis et al., 1993; Turpin & Huntzicker, 1995). EC is designated as a refractory light absorbing carbon and is emitted by incomplete combustion of organic substances (coal, gasoline, diesel, and biomass) used in different sectors such as transportation, industrial activities (organic solvent use, waste

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CARBONACEOUS AEROSOL VARIATIONS IN FOGGY DAYS: A CRITICAL ANALYSIS DURING THE FIREWORKS FESTIVAL

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ABSTRACT

The present study deals with the impact of firework activities on the variation of carbonaceous aerosols in Foggy days during in and around Diwali period vs. background period at three different sites, segregated on the basis of land-use pattern viz. JNU (dense vegetative), VN (residential) and AN (industrial) in Delhi, India. The average Organic Carbon, OC (99.24 µg/m^3) and Elemental Carbon, EC (24.31 µg/m^3) concentrations were found to be highest at VN, depicts the high influence of firework activities during Diwali and other significant sources like vehicular and commercial activities. OC/EC values generally fall in the range of 3.27 – 3.67 at all the sites during Diwali and Post Diwali, which indicates the formation of SOA. During Post Diwali, OC and EC concentrations showed a drastic decline at the day as compared to night, may be due to scavenging by the fog of carbonaceous aerosol particles resided after emission from fireworks only in morning hours. POC, Char and Soot percentage found to be high at JNU. This study is first of its kind to identify the nature of carbonaceous aerosols during foggy days that studied with respect to in and around firework activity.

KEYWORDS:
OC- EC Characterisation, Fireworks, Foggy days, Air Masses Movement.

INTRODUCTION

Fireworks generate a large amount of pollution in the form of smoke, dust and huge quantities of pollutants over a small period. They result in high levels of gaseous pollutants such as NO_x, SO_x, O_3, PAN, etc. [1-2], particulate matters [3], organic and inorganic compounds [4-9]. There are a number of festivals globally such as Las Fallas in Spain, Independence Day in the US, The Lantern Festival and Spring Festival in China, New Year Eve celebrations in various countries and Diwali festivals in India that are always celebrated with the burning of firecrackers. This short-term activity deteriorates the air quality on a large scale and can often cause serious health hazards to the population as well as visibility reduction for several hours [10-14].

Diwali is one of the main festivals of India, which celebrated with great passion all over India every year during the month of October or November as per the date decided by the local calendar. Generally, crackers constitute charcoal, a number of carbon compounds, trace elements and inorganic compounds. A large fraction of crackers consists of carbon-containing compounds [15]. A number of studies reported from all over the world on the impact of firework activities on air quality, but a very few studies reported on carbonaceous aerosols as compared to gaseous pollutants, metallic compounds and other trace metals. Vecchi et al. [16] reported the impact of firework activities focusing on heavy metal pollution on air quality of Italy during the FIFA World Cup event in 2006. Parkhi et al. [17] observed a number of criteria air pollutants, especially gaseous and particulate pollutants in Delhi during Diwali period of 2010 and 2011 under System of Air Quality and Weather Forecasting and Research (SAFAR) project. Kumar et al. [18] reported a number of water-soluble inorganic ions, carbonaceous aerosols and their relationships in Delhi during Diwali period of the year 2010. Thus, the present study provide carbonaceous aerosols variations studied during in and around firework activity during foggy days by selecting the representative site of each sector in Delhi, India.

Firework activities not only affect air quality but also the meteorological parameters such as visibility [14]. Besides this, extensive use of crackers during the festival are responsible for producing a high concentration of air pollutants, which affect one of the most important and challenging problems in almost all the countries, called as 'Fog'. This fog will interact with atmospheric aerosols, which are one of the main components of air pollutants present in atmosphere particularly in the metropolis areas and further contribute in the formation of secondary pollutants such as Secondary Organic Aerosol (SOA)

Mergers & Acquisitions in Indian Banking Sector during Pre and Post Global Financial Crisis: An Empirical Analysis

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Abstract

Merger and acquisition is a vital tool for the growth and expansion in any industry. It is needful for the survival of the weak banks by merging into the larger banks. The recent research shows the effect of mergers and acquisitions in the Indian Bank sector weather Mergers & Acquisitions has led to a gainful condition or not. For this purpose the comparison between pre and post-merger performance in terms of camel models. CAMEL model as a technique is very operative and resourceful and accurate to be used as a performance evaluation in banking industry future and relative risk CAMEL model stands for capital adequacy, Asset quality, Management Earning and Liquidity. In the current research some significant ratios are selected and intended to estimate banks performance. Data which is used in this study gathered from annual financial reports of sample Bank and after that data is compared with other bank's ratios and reports. The Primary motive of this experiment is to assess the influence of Mergers and Acquisitions in Indian banking sector, their situation before and after Mergers and Acquisitions and concluding out the details after these Mergers and Acquisitions with the benefit of CAMELmethod. In the current study secondary data is used which has been taken from articles, magazines, newspapers, books and websites, etc.

Keywords: Mergers and Acquisitions, CAMEL approach, Indian Banking Sector, banks have Private sector and Public sector banks.

Introduction

In the present globalized economy, aggressiveness and upper hands have become the trendy expressions for corporate around the globe. Organizations are dynamically utilizing Mergers and Acquisitions (M&A) basically for ingoing new markets, coordinating resource development, gathering more noteworthy piece of the overall industry/extra modern limits, and picking up adjusting blessings and capacities, and to turn out to be progressively unobtrusive in the commercial center. Mergers and acquisitions are utilized for refining astuteness of organizations and increasing aggressive advantage over different firms however increasing more prominent piece of the overall industry, extension the portfolio to lessen business hazard and entering new markets. There is contrast as far as effect on introduction following mergers, dependent upon the firm gained – inland or cross-fringe.

EFFECTS OF SEAWEED LIQUID EXTRACT ON SEEDLINGS GROWTH AND PIGMENT CONTENT OF *Vigna radiata*

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Abstract

The development in synthetic fertilizers and pesticides helped countries to increase their crop yield. However, at the same time it has also raised many issues related with soil fertility and degradation of the local ecosystem. Hence, there is a need to look for alternatives which not only can increase production to fulfill world food demand but also help in maintaining soil fertility without any negative impact on local environment. Amongst various available organic fertilizers, seaweeds are considered as a potential alternative to mainstream synthetic fertilizers, as these are rich in macronutrients, micronutrients as well as growth regulators, which directly help in the improvement of growth and yield of crop plants. In the present study effects of seaweed's liquid extracts from *Gracilaria* species on the growth and pigment contents in seedlings of *Vigna radiata* were evaluated. The results indicate that the addition these extracts significantly enhanced growth and pigment contents during seed germination.

Keywords: *G. cylindrica, G. verrucosa, G. edulis, G. corticata, G. crassa, Vigna radiata*, Biochemical Parameters, Growth Parameters, Seaweed Liquid Extracts (SLE).

1. Introduction

India is an agriculturally rich country and a large portion of its GDP comes from the agriculture and allied sectors. However, India's overall production of food crops has been increased several folds after green revolution still feeding all the people is a biggest challenge against government and scientists. International Food Policy Research Institute (IFPRI) has reported that India has moved from 97th to 100th place in 2017 on global hunger parameter. In addition the existing agriculture practices and trends of using chemical fertilizer lead to serious conditions which not only increasing water, soil and air pollution but also it is severely affecting human health. In addition bio-magnification of chemical fertilizers and pesticides resulted in various new diseases

Chapter 15
Fertilizers and Pesticides: Their Impact on Soil Health and Environment

Pooja Baweja, Savindra Kumar, and Gaurav Kumar

Abstract The agricultural practices around the world are dependent upon extensive use of fertilizers and pesticides. These chemical formulations are being added to improve crop quality and meet the global food demand. Fertilizers and pesticides are also considered as critical farmland tools for food security. On the other hand, the inorganic fertilizers and pesticides have many undesirable aspects which cannot be overlooked. They have properties to remain in soil and environment for a long time and affect various biotic and abiotic factors. They have adverse effects on soil, microflora, other organisms, environment, and human health. These undesirable properties of fertilizers and pesticides have led to the search of another option, i.e., sustainable agriculture, which is attracting the farmers and gaining the attention. In this system, the use of harsh chemicals is avoided and other methods such as organic farming, biofertilizers, composting, and use of bio control agents etc. are adopted and that is sustainable agriculture. Keeping all these aspects in view, this chapter aims at discussing various impacts of fertilizers and pesticides on soil structure, composition and environment along with the various alternatives to inorganic fertilizers and pesticides, so that preventive measures can be taken to conserve the nature.

Keywords Organic and inorganic fertilizers · Sustainable agriculture and environment · Chemical fertilizers and pesticides

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Refining Biomass Residues for Sustainable Energy and Bioproducts

Technology, Advances, Life Cycle Assessment, and Economics

2020, Pages 391-406

17 - Food industry waste biorefineries: future energy. valuable recovery. and waste treatment

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Abstract

Rapid increase in world population requires the introduction of advanced technologies to meet their demands of food and many other essential things. Increased industrialization resulted in continuous consumption of energy and material along with a huge amount of waste production. Slow-growing waste management approaches and other parameters for the treatment of waste, along with their disposal, escalate the problems of population. The treasure of food waste in the form of carbohydrates, proteins, lipids, and

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Current Developments in Biotechnology and Bioengineering

Resource Recovery from Wastes

2020, Pages 289-304

Chapter 15 - Bioeconomy of municipal solid waste (MSW) using gas fermentation

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Abstract

The rapid increase in population and urbanization has significantly contributed to the increased amount of agricultural, industrial, and municipal solid waste. Solid waste disposal and management have become a serious issue in today's world as it has

Chapter 8

Atmospheric Brown Carbon: A Global Emerging Concern for Climate and Environmental Health

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1 Introduction

Atmospheric aerosols are minute particles suspended in the atmosphere and participate in a significant function in changing climate. Many of these tiny particles impose several health-related issues in addition to climate effects. These small particles are released into the earth's atmosphere from the various natural and anthropogenic activities such as volcanic eruption, crop residue/biomass burning, emissions from industries and motor vehicles. Few particulates are organic (carbon and hydrogen-containing), whereas others are inorganic (such as sea salt and sulfates) (Adler et al., 2011). Mostly aerosol is sunlight reflecting in nature while others are absorbing. Carbonaceous aerosols (organic carbon and elemental carbon) play a significant role in changing climate, human health and air quality (Sonwani and Kulshrestha, 2018, 2019; Saxena et al., 2017). These carbonaceous aerosols emitted by the partial burning of fossil fuels through several processes such as industrial processes, traffic emission and biomass burning including domestic heating activities. The total carbon (TC) is usually separated in elemental carbon (EC) and organic carbon (OC) (Poschl, 2003; Poschl and Shiraiwa, 2015; Sonwani and Kulshrestha, 2019; Saxena et al., 2020). The optical determination methods of carbonaceous aerosol classify the refractory carbon as BC. BC particles released from combustion sources and considered as the very capable light-absorber in the visible range of sunlight (Bond et al., 2013; Bond and Bergstrom, 2006; Moosmüller et al., 2009). BrC is a different light-absorbing carbonaceous particle (Alexander et al., 2008;

Management of Contaminants of Emerging Concern (CEC) in Environment.
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Chapter 15

Investigating the Problem of Crop Residue Burning in an Indo-Gangetic Plain (IGP)—An Emerging Concern to Air Quality

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1 Introduction

Air pollution and its impact on human health is a very mysterical problem in Indian sub-continent (Badarinath et al., 2006; Pradhan, 2001; Sonwani and Kulshrestha, 2016). Past air pollution related Indian studies have reported peak concentrations of aerosols (Escuin et al., 2008; Murphy et al., 2008; Singh et al., 2009, 2015; Sandhu et al., 2018), $PM_{2.5}$ and PM_{10} (Gadde et al., 2009; Mittal et al., 2009; Vadrevu et al. 2011; Sonwani and Kulshrestha, 2018, 2019) and NOx (Sharma et al., 2003; Sharma and Maloo 2005; Schepers et al., 2014; Ghude et al., 2016). There are various factors like integration of pollutants in a particular area and transboundary movement of air masses processes (Singh et al., 2009; Godwin and Kobziar, 2011; Guttikunda and Jawahar, 2012; Saxena et al., 2020), increase in vehicular activities (Epting et al., 2005; WHO, 2016), thermal power plant emissions (Gurjar et al., 2010; Moorthy et al., 2013), industrial units which lack proper emissions control measures, biomass burning, and domestic activities (Simon et al., 1998; Satheesh et al., 2017; Saxena and Sonwani, 2019).

Management of Contaminants of Emerging Concern (CEC) in Environment.
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Policy Issues in Genetically Modified Crops

A Global Perspective

2021, Pages 371-400

Chapter 17 - Health Risks and Environmental Concerns of GM Crop Adoption

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What do these dates mean?

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Abstract

Agri-biotechnological approaches have introduced an expansion of genetically modified crops (GM) which has immense potential for betterment of agricultural practices. There are several possible benefits of GM crops includes high yield thereby solving food and nutritional security, producing herbicide tolerance, insecticide resistance varieties, reducing dependency on agrochemical thus reducing formers exposure to chemicals. However, potential risk and biosafety concerns are associated directly and indirectly with it. Flow of genetic information, generation of super-weed, adverse effects on beneficial