

# Discovery Novelty Aspiration



An endeavour by Department of Microbiology



# St. Xavier's College (Autonomous), Kolkata

# DEPARTMENT OF MICROBIOLOGY

Presents



The Official Publication of

# **MODERN TRENDS IN MICROBIOLOGY, 2022**

#### CHAPTER XIX

POWERED BY CO-POWERED BY TRA GENERAL HOSPITAL Suvan Life Sciences; JAM Coaching

Supported by

DEPARTMENT OF BIOTECHNOLOGY, GOVT. OF INDIA

(Under DBT Star College Scheme)

Two Days International Seminar

Date: 23<sup>rd</sup> & 24<sup>th</sup> of September, 2022

Time: 9:00 AM onwards on 23rd of September

10:00 AM onwards on 24<sup>th</sup> of September (IST)

Editor: Dr. Arup Kumar Mitra Student Editors: Amrita Roy and Dip Burai Cover Design & Illustration: Bartik Saha

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# **MODERN TRENDS IN MICROBIOLOGY**

#### NINETEENTH CHAPTER

23<sup>rd</sup> and 24<sup>th</sup> September2022

#### Convener: Dr. Arup Kumar Mitra Student Conveners: Soumyadip Biswas and Teesta Bhowmick Student Co-Conveners: Ronit Dey and Shrijeet Kolley

# CORE COMMITTEE

Professors in-charge:	Dr. Sudeshna Shyam Chowdhury
Members:	Soumyadip Biswas, Ronit Dey, Ujaan Roy, Teesta Bhowmick, Shrijeet Kolley

## **WORKING COMMITTEE**

#### **PUBLICATION COMMITTEE-**

Professors in-charge:	Dr. Sudeshna Shyam Chowdhury
Student Coordinators:	Amrita Roy and Dip Burai
Members:	Zubia Zain, Adith Das, Soham Das, Purbita Gangapadhay, Debadrita Roy, Rittika Singh, Nikita Parui

#### **REGISTRATION COMMITTEE-**

Professors in-charge:	Dr. Anindita Banerjee
Student Coordinators:	Diksha Neogy and Arkajyoti Sanyal
Members:	Ujaan Roy, Anupriya Das, Sharanya Sreemani, Megharanjani Mitra, Sougata Roy, Mayurakshi Pal, Sagnik Das

#### **PUBLICITY COMMITTEE-**

Professors in-charge:	Dr. Kasturi Sarkar
Student Coordinators:	Paranjita Raha and Sreenjoy Saha
Members:	Avishek Datta, Sampurna Bardhan, Rithik Wilson Ninan, Devhuty Chakrabarty, Niharika Paul, Kazi Atifa Ahmed, Sikta Roy

#### **FINANCE AND FOOD COMMITTEE-**Professors in-charge: Dr. Arup Kumar Mitra and Dr. Jaydip Ghosh .0 Student Coordinators: Ujaan Roy and Subarna Pahari Members: Soumyadip Biswas, Ronit Dey, Teesta Bhowmick, Sreenjoy Saha, Bartik Saha, Ritojo Basu, Shrijeet Kolley, Zubia Zain **DESIGNING COMMITTEE-**Professors in-charge: Dr. Madhumita Maitra Student Coordinators: Ankita Banerjee and Bartik Saha Hena Khamaru, Titas Chakraborty, Dhrubaneel Biswas Members: PRESENTATION AND PROGRAM COMMITTEE-Professors in-charae: Dr. Riddhi Majumder

r ojessors in enarge.	
Student Coordinators:	Adrija Biswas and Anirban Das
Members:	Dwijattam Mukherjee, Urbi Ghosh, Mark Abhishek Perris, Rukaiya Gheewala, Dipabali Biswas, Aritra Ghosh, Annette Ann Felix, Arijit Halder, Saptarshi Saharay

#### HALL AND STAGE COMMITTEE-

Professors in-charge:	Prof. Debjani Dutta
Student Coordinators:	Rittika Nandi, Srijita Paul, Purbita Gangapadhay
Members:	Nazir Hossain, Saptarshi Mondal, Archit Bhattacharya, Somangee Chakrabarti, Anondi Mandal, June Page, Sayan Kamila

## **AWARD COMMITTEE-**

Professors in-charge:	Dr. Mahashweta Mitra Ghosh
Student Coordinator:	Arnab Mukherjee, Ritojo Basu, Aritra Ghosh
Members:	Tamanna Dey, Susmita Kar, Swapneel Saha, Ananya Konwar, Swatilekha Bhattacharjee, Soubhagyo Ghosh, Angela Natasha Joseph

#### **CULTURAL COMMITTEE-**

Professors in-charge:	Dr. Sudeshna Shyam Chowdhury, Dr. Jaydip Ghosh, Prof. Lopamudra Roy
Student Coordinators:	Saranya Trivedi, Shubhangi Dutta, Ishita Chanda, Sneha Das
Members:	Tanisha Chakraborty, Anondi Mandal, Nandona Sen, Debangshi Ray, Subarna Pahari, Nisha Bhat

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# Our department is beholden to the following people for their wholesome and immense support.

Mr. Biswanath Sen, Mr. Pintu Biswas, Mr. Bittu Baidya, Mr. Debashish Das, Mr. Ashim Mondal.



#### *The Principal* ST. XAVIER'S COLLEGE (AUTONOMOUS)

*30, Mother Teresa Sarani* (Park Street) Kolkata - 700016





# MESSAGE

I take this opportunity to congratulate the Department of Microbiology, St. Xavier's College (Autonomous), Kolkata for taking this initiative of organizing the 19th chapter of its annual seminar 'Modern Trends in Microbiology', popularly known as MTIM. After every bad day, comes a good day and we should wait for it. Similarly, after two whole years of pandemic life, being isolated in our homes and conducting only webinars behind the computer screen, the department has full fledgedlygeared up againto put in their untiring effortsso as tobring to life its annual seminar, which is to be held from 23rd September 2022 to 24th September 2022. The department has successfully invested in expanding and proliferating the stretch of students' knowledge in the fields of the recent advancements which have sub surfaced in the field of microbiology.

The department has had a tradition of successfully blending academic and extracurricular activities which is showcased in this two-day scientific seminar. Combining the expertise and dedication of faculty and students in the department, the seminar intends to stage a platform for students from different universities across the state to participate in interactive lectures, oral and poster presentations. In particular, our esteemed guest speakers will reach out to the audience and enlighten them with their invaluable knowledge and research expertise.

I wish the Department all the best and express my belief in the diligence, devotion and integrity shown by the Department's students and professors in organizing the MTIM.

May God bless you all! Nihil Ultra!

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Rev. Dr. Dominic Savio, S.J.



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# The Vice Principal Arts and Science Department ST. XAVIER'S COLLEGE (AUTONOMOUS)

*30, Mother Teresa Sarani* (Park Street) Kolkata - 700016





# MESSAGE

The Department of Microbiology has been hosting Modern Trends in Microbiology, its annual seminar for the past eighteen years, which is a remarkable achievement of consistent excellence and sincerity which deserves to be applauded and praised. It certainly signifies the department's commitment to research and investigation and publication.

The seminar provides a space for the students and faculty where they can share their research with others and ruminate together to percolate discussion, arguments and even hypotheses. It provides a platform of interactivity which can genuinely inspire and motivate young minds towards the pursuit of scientific knowledge. It truly embodies the essence of scientific enquiry in its goal of always pursuing the unknown.

So, I deeply appreciate the Department of Microbiology for its rigorous discipline of its academic commitment.

Prof. Bertram Da' Silva



#### *The Dean of Arts* ST. XAVIER'S COLLEGE (AUTONOMOUS)

1444

*30, Mother Teresa Sarani* (Park Street) Kolkata - 700016



# MESSAGE



The Microbiology Department, St. Xavier's College (Autonomous) Kolkata, has always been at the forefront of research activities in the institution. This event has been at the Pinnacle for innovation and creativity in microbiology and related areas of microbiology. The departmental magazine "DNA" ('e-DNA), which is primarily an endeavour of the students of the Microbiology department, this year will be in its nineteenth year-since its inception. The compilation of a wide gamut of interesting articles on varied topics, going much beyond the curriculum, speaks volumes about the genuine commitment and involvement of the students is platform creates a wider opportunity to enhance the skills and experiences gathered by our students. Also, various other colleges and universities participate in this event. I would like to take this opportunity to congratulate the department on this ingenious effort and wish them success in the future as well. Best wishes!

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Dr. Arghya Banerjee

*The Dean of Science* ST. XAVIER'S COLLEGE (AUTONOMOUS)

*30, Mother Teresa Sarani* (Park Street) Kolkata - 700016





# MESSAGE

It gives me immense pleasure to inform that the Microbiology Department of St. Xavier's College, Kolkata has reached its nineteenth year since inception in publishing its departmental Journal "DNA", which has always been primarily an endeavour of the students. Every year the conduction of Modern Trends in Microbiology has been a successful which enhances the students to come up with new research ideas and application of microbiology in daily life. The Journal contains an eclectic ensemble of scientific research articles from outside the syllabi of the under-graduate and postgraduate curriculum which clearly shows why the Department of Microbiology is in the forefront of research activity in the College. It reflects the enthusiasm, dedication and motivation of the students in the subject. I would like to take this opportunity to congratulate the Department on this endeavour and wish them Success.

Best wishes!

Dr. Tapati Dutta



# ST. XAVIER'S COLLEGE (AUTONOMOUS) Department of Microbiology

*30, Mother Teresa Sarani* (Park Street) Kolkata - 700016



# MESSAGE



The Department of Microbiology has always been at the forefront of research activities in this institution. I, as the convener of "**Modern Trends in Microbiology 2022**", would like to thank all my students, fellow colleagues and support staffs for their persistent endeavor to organize and execute this TWO-DAY NATIONAL SEMINAR successfully. The genesis of this seminar has always aimed at academic excellence in students and we are glad to declare that our students have achieved it. The papers & posters which have been assembled in this edition of "DNA VOLUME – 9" and presented in the seminar – are diligently written, elaborately defined.

This "**NINETEENTH CHAPTER OF MODERN TRENDS**" will certainly provide an academic platform; not only for our students but also for young minds participating in poster presentations from other colleges.

Finally, I would like to thank Father Principal, Vice Principal, respected Deans of Arts & Science for allowing us to organize this event.

I wish all the success to this event!

Amitra.

Dr. Arup Kumar Mitra

Convener Modern Trends in Microbiology (Chapter XIX)

# ST. XAVIER'S COLLEGE (AUTONOMOUS) Department of Microbiology

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# MESSAGE

It has been a very delightful experience in organizing the 19<sup>th</sup> chapter of "Modern Trends in Microbiology". This type of seminar is a very good forum to inculcate knowledge of Biological Science amongst our students. With immense enthusiasm and zeal, the students go through various research papers and prepare for their oral presentation and poster presentation. The seminar provides the student a platform to showcase their scientific proficiency. Renowned scientists acquaint us with their significant scientific research works. This seminar provides us the opportunity to gain knowledge about the modern research works and aspects of Biological Sciences. In this endeavor, I got immense help from my colleagues, the UG and PG students of the Department. It is very strong belief that this event will attain a great success in all respects and the untiring efforts of the students and my fellow colleagues will be recognized.

I sincerely wish all my students all the best and trust that their meritorious and ingenious efforts will be successful.

Nihil Ultra!

Sich Myen chally

Prof. Dr. Sudeshna Shyam Choudhury

Head of the Department



ST. XAVIER'S COLLEGE (AUTONOMOUS) Department of Microbiology

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MTIM 2022

# MESSAGE



Modern Trends in Microbiology (MTIM) is the signature event of the Department of Microbiology, St. Xavier's College (Autonomous), Kolkata. The journey of MTIM began eighteen years ago and since then, the legacy is continuing. After two whole years of pandemic life, and conducting this event in the form of webinars behind the computer screens, we are back with MTIM Chapter XIX which is going to be conducted offline. It gives us immense joy to conduct our seminar, because of the zeal that exists within the hearts of all the organizers, coordinators, and participants. It has been a roller-coaster ride for us, with many ups and downs, but together, as one force, we all have given our very best to bring together all the small jigsaw puzzle pieces to make this event a success. It has been a journey, filled with challenges, knowledge, hard work and fun, nevertheless, making countless memories.

We take this opportunity to thank Father Principal, Vice Principal Sir, Sir and Madam of Dean of Arts and Science, our most beloved, godmother of the department, our HOD ma'am, and last but not the least, Dr. Arup Kumar Mitra, our MTIM convenor who has been the driving force and a constant source of inspiration and motivation for us to work to the best of our capabilities. We would also thank our batchmates, seniors, juniors and all participants for joining us in this journey and having the enthusiasm and eagerness to make MTIM 2022 which will reside in the hearts а grand success, of people forever.

Sormyadip Biswas

Soumyafip Biswas

(PG Student Convenor)

Teesta BLOWN **Teesta Bhowmick** 

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(UG Student Convenor)

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The two of us come from different batches and practically have zero experience in organizing something as big as this. So, when we say that we are nervous, excited, and basically going through a thousand different emotions at the same time regarding how everything might turn out to be like, we really aren't joking. MTIM has been by far one of the most happening, and fun events we have been a part of. The number of new things we have learnt is immaculate and is in no way in comparison to what we have done earlier. The best part of this was being able to be a part of everything that was happening starting from registrations to the cultural performances and even the arrangement of the food. So, all we hope is our hard work pays off and that all participants, students and professors have a gala time at MTIM Chapter XIX.

Ronit Day

Ronit Dey (PG Co-Convenor)

hunjeet Knung

Shrijeet Kolley

(UG Co-Convenor)



# **MTIM 2022 CHAPTER XIX**

# **CORE COMMITTEE MEMBERS**



# **SOUMYADIP BISWAS**



**TEESTA BHOWMICK** 



# **RONIT DEY**



# **UJAAN ROY**



# **SHRIJEET KOLLEY**

As we all sit together to write down this message for our readers, it feels great that all our hard work, efforts, long hours and most importantly the countless arguments, fights and creative differences are coming to fruition. Seeing everything fall in place like this is basically like a dream come true for all of us in the core team and we hope that this offline edition of the 19<sup>th</sup> Modern Trends in Microbiology goes down in history as one of the best that has been ever done.



# **MTIM 2022 CHAPTER XIX**

# **PUBLICATION COMMITTEE CONVENORS**



# **AMRITA ROY**



# **DIP BURAI**

Finally, the wait is over, here we have "e-DNA" or say Discovery, Novelty and Aspirations. This isn't just a book of some construction of words and pictures, rather a whole set of new inventions, innovations and creations from all young minds from different students coming from different colleges and our home students of course. We are just spellbound to see those creativity and hardly can resist ourselves to compile those articles into this magazine. The journey of making this book is beautiful and made some lifelong memorable moments, where it wouldn't be possible to accomplish without the guidance of teachers, seniors and juniors.

# **REGISTRATION COMMITTEE CONVENORS**



**DIKSHA NEOGY** 



# **ARKAJYOTI SANYAL**

Modern Trends in Microbiology (MTIM) being the most awaited annual event is finally back with a zeal! This year we have been lucky enough to be able to organize it in the offline mode. Being in the Registration Committee, we can definitely say that the responses have been really overwhelming from both within as well as outside the college. That itself shows how much everyone is hyped up about the event. It was truly a delightful experience to actively take part in this grand event and ensure its success!



# MTIM 2022 CHAPTER XIX

# **PUBLICITY COMMITTEE CONVENORS**



# PARANJITA RAHA



# **SREENJOY SAHA**

We are glad to have been a part of the Organisisng Committee of Modern Trends in Microbiology, Chapter XIX, organized by our Microbiology Department. As the covenors of Publicity Committee, we, along with our fellow members have tried to contribute our level best in taking this flagship event, close to our heart, towards success. We can just look forward to maximum participation and holistic involvement of students, faculty, research scholar and everyone interested in Biological Science.

# FINANCE AND FOOD COMMITTEE CONVENORS



**UJAAN ROY** 



# SUBARNA PAHARI

Pulling off MTIM Chapter XIX in this post-covid period wasn't easy at all. However, it gives us immense joy to say this with 100% confidence that the seminar is FINALLY HAPPENING exactly the way it used to be 2 years back, in fact even bigger and better. We are whole-heartedly grateful to all our well-wishers and benefactors for helping us to stage this two-day event. Both of us along with our entire finance team have given every ounce of our energy to make MTIM Chapter XIX a grand success.



# **MTIM 2022 CHAPTER XIX**

# **DESIGNING COMMITTEE CONVENORS**



# **ANKITA BANERJEE**



**BARTIK SAHA** 

MTIM is a legacy of our department and thus the expectations were set very high. While exploring the new advances in biological science, being a part of this event also let us showcase our artistic side. As conveners of the designing committee, we had one of the most challenging responsibilities i.e., to make the event look sharp and attractive. However, we enjoyed every moment working to make this event one of a kind. A lot was to be done in a short span of time but the excitement made it all worth it.

# **PRESENTATION AND PROGRAM COMMITTEE CONVENORS**



**ADRIJA BISWAS** 



**ANIRBAN DAS** 

Our experience as a part of the presentation committee was enriching. We learnt a lot about originazing an event of this granndeur. We enhanced our organizational skills. We wish to make it a success.



# **MTIM 2022 CHAPTER XIX**

# HALL AND STAGE COMMITTEE CONVENORS



# **RITTIKA NANDI**



# **SRIJITA PAUL**



# PURBITA GANGAPADHAY

"Success is the sum of small efforts, repeated!" We must say that organizing MTIM offline and reviving the Hall and Stage committee after two long years felt a little daunting but we had immense support and encouragement from every member of MTIM 2022. We have dealt with every detail and worked enormously to make this event a tremendous success. It gives us immense pleasure to watch our hard work pay off.

# **AWARD COMMITTEE CONVENORS**



# **ARNAB MUKHERJEE**



# **RITOJO BASU**



**ARITRA GHOSH** 

We are glad to organise the MTIM in the offline version after two years of pandemic life with full vigour and grandness. We hope our hardwork for the last two months will bring fruit and we will have a great season this time.





SARANYA TRIVEDI



# **SHUBHANGI DUTTA**



**ISHITA CHANDA** 



## **SNEHA DAS**

We are deeply honoured and overwhelmed to present a glorious cultural event at the Modern Trends in Microbiology, 2022. We'll be showcasing the range of skills that the students in our department possess.

MTIM has been a brimming cup of difficulties, learning, effort, and enjoyment. It's harder than it looks to plan and carry out a great cultural event over both the days. All of our backstage heroes had to be patient and persistent to get through it. We sincerely appreciate the support of each and every member of our team and well-wishers, without whom we could not have persevered.





# MTIM 2022 CHAPTER XIX

# **PHOTOGRAPHERS**



**RONIT DEY** 



**AVISHEK DATTA** 



JUHITA DHAR



**DIP BURAI** 



TALAHA NISHAT AHMED



SOUKARYA MAJUMDER

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# MTIM 2022 CHAPTER XIX

Special thanks to



**ROUNAK DAS** 

For his immense untiring effort in Videography and Photography.



# ACHIEVEMENTS

The path so far...

#### **Dip Burai**

Dept. of Microbiology, B.Sc, 2<sup>nd</sup> Year

St. Xavier's College (Autonomous), Kolkata

The Microbiology Department of St. Xavier's College had started its journey almost nineteen years ago. Since the very beginning, the indomitable enthusiasm and the eagerness of the faculty as well as the students to reach the zenith of perfection have made our Department secure a stronghold in the field of research activity in our college. The sincere guidance and tireless endeavour of our beloved faculty members have nurtured the Department and helped it to prosper to magnificent stature. We, the students, hereby take immense pride and pleasure in presenting "Modern Trends in Microbiology, Chapter XIX", the annual departmental fest-cumseminar by the students of our Department supervised by our founder Head, Dr. Arup Kumar Mitra and our present HOD, Dr. Sudeshna Shyam Chowdhury.

#### Some notable accomplishments by the faculty members of our Department:

- Suhana Datta from University of Calcutta, Tamanna Sultana and Puja Agnihotri from St.Xavier's College completed their Ph.D.under the guidance of Dr.Arup Kumar Maitra.
- > Dr.Arup Kumar Maitra has wrote 4 book chapters and has published 9 papers in referred journals.
- Dr. Arup Kumar Maitra has initiated DBT builder program with a major project in collaboration with University of Gdansk and IIT Delhi.
- > Dr.Arup Kumar Maitra has also started the study of particulated matter (spm 2.5) in Kolkata.
- > A new project on Ghoramara island in Sundarban in collaboration with New York University.
- He was also the main convener of International Seminar On Climate Change which held at St.Xavier's College.
- Assessment of Antioxidant and Antimicrobial (Therapeutic) Potentials of Some Medicinally Important Beverages - by Sudeshna Shyam Choudhury, Ravichandran Velayutham, Dipanjan Ghosh, Arun Jana, Jaydip Ghosh, Sejuti Ray, Debapriya Maitra.Research and Reviews: Journal of Herbal Science,Volume 10, Issue 2, 2021,pg-8-13.
- Biotechnological applications Extremophiles: The golden epoch ahead-by Bedaprana Roy, Debapriya Maitra, Rajeshwari Podder, Jaydip Ghosh and Arup Kumar Mitra. Gave a Chapter in a book entitled: "Extremophiles: A Paradox of Nature and its Biotechnological Implications" by De Gruyter, Berlin, Germany. (Accepted) 2022.
- Unique Extremophillic Bacillus: Their Application in Plant Growth Promotion and Sustainable Agriculture–by Bedaprana Roy, Debapriya Maitra, Jaydip Ghosh and Arup Kumar Mitra. Chapter in a book entitled "Microbes and Microbial Biotechnology for Green Remediation Microbes and Microbial Biotechnology for Green Remediation." (2022) by Elsevier, Amsterdam, Netherlands.
- Ms. Puja Agnihotri second scholar under Dr.Madhumita Maitra has submitted her thesis from St. Xavier's College, C.U
- Dr. Madhumita Maitra was involved in Career Counselling of the undergraduate students of the life Sciences at Basirhat College, under W.B State University on 12<sup>th</sup> June 2022.
- Isolation, characterization, and identification of an as(v)-resistant plant growth promoting rhizobacterium associated with the rhizosphere of Azolla microphylla -

- P. Agnihotri, M. Maitra and A K Mitra, June 2022 Journal of Microbiology, Biotechnology and Food Sciences.
- Effect of combination of Azolla microphylla and As(V)-resistant bacterial consortium on growth, oxidative stress and arsenic accumulation in rice plant under As(V) stress P. Agnihotri,S Sikdar, M Maitra, S S Choudhury, A K Mitra, February 2022 International Journal of Plant Research
- Dr. Madhumita Maitra is the author of one of the chapters of the Book entitled "Research Advances in
- the Fungal World" Chapter 16. Fungal Lignocellulolytic enzymes: Physiological roles &
- Biotechnological applications;
- > Dr. Lopamudra Roy submitted her Ph. D. thesis to University of Calcutta.
- Dr. Lopamudra Roy has published a book chapter, The symbiotic relationship between fungi and plants [3<sup>rd</sup> Volume (Sustainable Utilization of Fungi in Agriculture and Industry) of the Series – Mycology: Current and future developments]. Bentham Science Publishers.
- Dr. Lopamudra Roy participated in an Invited Panel Discussion on 'How to make our World more habitable', on 'World Environment Day', broadcasted on Akashvani Maitree (Prasar Bharati) in 2022.
- > Dr. Mahashweta Mitra Ghosh published four papers and wrote two book chapters.
- > Dr. Kasturi Sarkar also has published two research papers.
- 1<sup>st</sup> position in Poster presentation titled "Role of residual microflora from Indian spices in increasing their shelf life" was secured by Debjani Dutta, Debdatta Das, Debapriya Maitra, Bedaprana Roy and Arup Kumar Mitra in senior category in The International Conference on Climate Change: a Global Cooperation, held on 26<sup>th</sup> and 27<sup>th</sup> August,2022 organized by the Department of Environmental Science, St. Xavier's College, Kolkata.
- Under Dr. Sudeshna Shyam Choudhury's guidance, Mr.Pritam Biswas, a scholar has completed his Ph.
  D.

#### Notable achievements by Ph.D. Scholars:

#### Sedaprana Roy:

- Dinda S, Maitra D, Roy B, Khan P, Samajdar A, Mitra A.K, Roy S, Pramanik K, Ganguly S, Molecular and Electronic Structures, Spectra, Electrochemistry and Anti-bacterial Efficacy of Novel Heterocyclic Hydrazones of Phenanthrenequinone and Their Nickel(II) Complexes", Chemistry Select. <u>https://doi.org/10.1002/slct.202202151</u> (2022)
- Bedaprana Roy, Debapriya Maitra, Jaydip Ghosh and Arup Kumar Mitra (2022)."Unique Extremophillic Bacillus: Their Application in Plant Growth Promotion and Sustainable Agriculture". in a book entitled "Microbes and Microbial Biotechnology for Green Remediation Microbes and Microbial Biotechnology for Green Remediation." by Elsevier, Amsterdam, Netherlands. https://doi.org/10.1016/B978-0-323-90452-0.00021-9
- Roy Bedaprana, Debapriya Maitra, and Arup Kumar Mitra (2021). "Methods of Sample Preparation and Assay of Bacterial Biofilms with Special Reference to Their Significance in Agriculture and Extreme Environments." Analytical Methodologies for Biofilm Research. Springer, New York, NY, 2021. 39-65.
- Mitra A. K, Mukhopadhyay M, Mondal S, Ghosh P, Chattopadhyay S, Ganguly R, Kanjilal P, Kundu S, Maitra D and RoyS, (2022) Statistical Analysis of the Effect of Bacterial Consortia in Soybean Production, Acta Scientific Microbiology (ISSN: 2581-3226), DOI: 10.31080/ASMI.2022.05.1056
- Maitra D, Roy B, Choudhury S.S, & Mitra A.K., Dynamics of soil microbiome and their role in sustainable agriculture., Springer Nature Book: "Bioremediation and phytoremediation for sustainable

- soil management."Springer Nature (2022). Hardcover ISBN: 9783031088292, eBook ISBN: 9783031088308
- Sultana T, Maitra D, Roy B, Mitra A. K, & Savarimuthu X, S.J., Dynamic role of specific microbes in bioremediation of heavy metals and dyes from the textile industry, Go Green for Environmental Sustainability: An interdisciplinary exploration of theory and applications. Taylor and Francis Group., CRC Press. (2021) eBook ISBN9781003055020

#### Bikram Dhara:

#### **Papers Published:**

- BikramDhara, Roy, I. & Maity, A. Comparative Account of the Genotoxic and Antimicrobial Effects of Silver Nanoparticles Synthesized from Extract of *PleurotusOstreatus* and Chemically Synthesized Nanoparticles. *Cell Tiss. Biol.* 15, 77–89 (2021). <u>https://doi.org/10.1134/S1990519X21010028</u>
- Chatterjee, S., Dhara, B., Mukherjee, D., Mukhopadhyay, D., &Mitra, A. K. (2021). A review on the SARS-CoV-2 mediated global pandemic: proximal origin, pathogenicity and therapeutic approaches. *J AntivirAntiretrovir*, *13*, 220.
- Biswas, T., Mondal, M., Bhattacharya, S., Sarkar, M., Dhara, B., Mitra, A. K., & Chandra, A. (2021). Covid-19 and the South Asian Countries: factors ruling the pandemic. *medRxiv*.
- Bhattacharya, A., Mondal, S., Santra, M., Dhara, B., Kundagrami, S., Lankipalli, V. S., & Mukherjee, D. (2022). Effects of hERG K+ channel beyond prolonged QT syndrome.
- Dey, M., Chatterjee, S., Dhara, B., Roy, I., &Mitra, A. K. (2022). Promoting crop growth with symbiotic microbes in agro-ecosystems—I. In *Microbes and Microbial Biotechnology for Green Remediation* (pp. 117-133). Elsevier.
- Roy, S., Bhowmik, S., Chowdhury, A. D., Dhara, B., &Mitra, A. K. (2022). Plant growth-promoting rhizobacteria: an alternative for NPK fertilizers. In Microbes and Microbial Biotechnology for Green Remediation (pp. 149-167). Elsevier.
- Paul, S., Biswas, S. J., Halder, P., Prasad, R. K., Dey, R., Dhara, B., &Mitra, A. K. (2022). A Critical Review of COVID 19 Vaccines: Past, Present and Future.
- Bhattacharya, Arghya, SoumikBhattacharjee, Sumit Nandi, Tathagata Roy, RajashreeSabui, Sudip Roy, BikramDhara, and Dattatreya Mukherjee. "Antifertility: ItsEthnopharmacological Advancement." (2022).

#### Patent:

**1.** Complete genome sequence of Burkholderiacontaminans strain OYA 0603 a plant growth-promoting rhizobacterium isolated from soybeans. Application number- 202231042244. (Indian Patent Office)

#### Debapriya Maitra Mukherjee:

#### **Papers Published:**

• Won Best Paper Presentation in oral presentation category at one day national symposium titled "Bio Nexus: A new axis for advanced biological sciences" organized by Department of Biotechnology, School of Science and Tecchnology, Neotia University, 2022.

#### **Publications:**

- Maitra D, Roy B, Choudhury S.S, & Mitra A.K., Dynamics of soil microbiome and their role in sustainable agriculture., Springer Nature Book: "Bioremediation and phytoremediation for sustainable soil management."Springer Nature (2022). Hardcover ISBN: 9783031088292 eBook ISBN: 9783031088308
- Roy B, Maitra D & Mitra A.K. Methods of sample preparation and assay of bacterial biofilms with special reference to their significance in agriculture and extreme environments, Springer Protocol Handbook, Analytical methodologies for biofilm research, Springer Nature, ISBN 978-1-0716-1378-8, doi: <u>https://doi.org/10.1007/978-1-0716-1378-8\_2</u>
- Sultana T, Maitra D, Roy B, Mitra A. K, & Savarimuthu X, S.J., Dynamic role of specific microbes in bioremediation of heavy metals and dyes from the textile industry, Go Green for Environmental Sustainability: An interdisciplinary exploration of theory and applications. Taylor and Francis Group., CRC Press. (2021) eBook ISBN9781003055020
- Roy B, Maitra D, Ghosh J, & Mitra A.K., Unique extremophilic Bacillus: Their application in plant growth promotion and sustainable agriculture., Microbes and microbial biotechnology for green remediation. Book chapter., Elsevier (2022) ISBN: 978-0-323-90452-0
- Mitra A. K, Mukhopadhyay M, Mondal S, Ghosh P, Chattopadhyay S, Ganguly R, Kanjilal P, Kundu S, Maitra D and RoyS, (2022) Statistical Analysis of the Effect of Bacterial Consortia in Soybean Production, Acta Scientific Microbiology (ISSN: 2581-3226), DOI: 10.31080/ASMI.2022.05.1056
- Choudhury S S, Velayutham R, Ghosh D, Jana A, Ghosh J, Ray S, Maitra D (2021), Assessment of Antioxidant and Antimicrobial (Therapeutic) Potentials of Some Medicinally Important Beverages, Research & Reviews: Journal of Herbal Science, ISSN: 2278-2257 (Online), ISSN: 2348-9553 (Print), Volume 10, Issue 2, 2021, DOI (Journal): 10.37591/RRJoHS

#### **\*** Sanjana Ghosh:

- Presented a paper entitled Isolation and characterization of lead tolerant plant growth promoting bacteria from rhizosphere of *Cucurbita maxima* of reclaimed wetland soil at Neotia University on April,2022
- Worked as a resource person and presented a paper entitled Agriculture post India's Independence: A journey towards self-sufficiency at Maulana Abul Kalam Azad Institute of Asian Studies (MAKAIS) on 14<sup>th</sup> August,2022.
- Two novel bacterial strains reported in NCBI :
  - *a)* Bacillus velezensis strain DPPB\_SGAM\_SXC 16S ribosomal RNA gene,partial sequence.ACCESSION ON384543. Published on 30/4/2022
  - *b)* Cupriavidusnecator strain DCPA\_SGAM\_SXC 16S ribosomal RNA gene, partial sequence.ACCESSION ON384541. Published on : 30/4/2022
- Communicated a book chapter entitled "An Insight To Microbial Metagenome in Wetland Ecosystem." for the book Bacterial Metagenomics in Industrial Wastewater Treatment by DE Gruyter
- Presented a poster entitled MICROBIAL METAGENOME ANALYSIS OF *Cucurbitas*p RHIZOSPHERE FOR A SUSTAINABLE AGRICULTURE IN EAST KOLKATA WETLANDS in an

International Seminar titled International Conference on Climate Change: Global Cooperation organized by St. Xavier's College (Autonomous),Kolkata o 26<sup>th</sup> and 27<sup>th</sup> August,2022

#### Rupsha Karmakar:

- Singh, M., Karmakar R., Ganguli S., Ghosh, MM. (2021). Report of Antibiotic Resistance inUrban and Rural Wastewaters from West Bengal, India. Journal of Pharmaceutical ResearchInternational, 33(53A):274-285. DOI: 10.9734/jpri/2021/v33i53A33660
- Ganguli, S, Karmakar, R, Singh, M & amp; Ghosh, MM. Metagenomics-Guided Assessment of WaterQuality and Predicting Pathogenic Load. Handbook of Research on Monitoring andEvaluating the Ecological Health of Wetlands; ISBN 9781799894988 (hardcover) | ISBN9781799895008 (ebook) 2022; Chapter 5: 71- 91.
- Basu, S, **Karmakar, R,** Gupta, S & amp; Ganguli, S. Developing your "Resilience Bank account"-Areyou ready for the next Pandemic? Covid- 19 and Year 2020 Volume 1. Eds: Dr. SmritiratanTripathy. 2021; 54-65.

#### Souradip Basu:

#### **Publications:**

- Basu, S., Gupta, S., Das, K., Bagchi, S.S. & Ganguli, S. (2022). Tribal Ethnomedicine: a rich resource for future drugs. Indigenous Traditional Knowledge, ISBN: 978-81-955847-0-3. DOI: 10.5281/zenodo.6418656
- Basu, S., Das, K., Ghosh, M. M., Banerjee, R., Bagchi, S. S., & Ganguli, S. (2022). First report of gut bacterial dataset of a tribal Bhutia family from West Bengal, India. Data in brief, 41, 107859. https://doi.org/10.1016/j.dib.2022.107859
- Basu, S., Das, R., Gupta, S., & Ganguli, S. (2021). Does Air Quality Influence the Spread of the Sars -Cov2 In Metropolitan Cities? -A Case Study from Urban India. Current World Environment, 16(2). DOI: 10.12944/CWE.16.2.27

#### **Poster & Oral Presentations:**

- Poster Presentation at a symposium of the Society of Biological Chemists (I), Kolkata Chapter in Sister Nivedita University (9 th- 10 th April, 2022). The title of the presentation is "Dietary intake and uniformity of the gut microbiome - A case study from a Bhutia Tribal Family of West Bengal".
- Oral Presentation at Indian Anthropological Congress (IAC) in collaboration with Department of Anthropology, University of Hyderabad organized by INCAA on Anthropology and Bio-Cultural Diversity in India: Retrospect & Prospect (21st- 23rd February, 2022). The title of the presentation is "Insight into the applications of Pharmacogenomics on Gut Microbiome and Tribal Ethnomedicine".

Oral presentation at International Symposium in Amrita Vishwa Vidyapeetham, CHARM at University of California San Diego, Bugwork Inc. and C-CAMP organized by School of Biotechnology on Anti-Microbial Resistance (24th-26th February, 2021). The title of the presentation is "What does the tribal child gut microbiome tell us- a comparison of Bhutia, Mech and Savar guts".

#### Debdatta Das:

- 1st position secured in senior category at the poster presentation competition held as part of the seminar "International Conference on Climate Change: Global Cooperation". Poster title: Role of residual microflora from Indian spices in increasing their shelf life.
- Paper selected for publication in the 'Journal of Environment and Sociobiology'. Paper title: Role of residual microflora from Indian spices in increasing their shelf life.
- Abstract accepted for book chapter publication in "Environmental Approach to remediate Refractory pollutants from Industrial wastewater Treatment Plant"-by ELSEVIER (The Netherland). Chapter title: Microbial intervention in the management refractory wastes.

#### Notable achievements by the students, this year:

- Rishika Chaterjee A pattern of Covid morbidity expression in the industrial backdrop of Paschim Burdwan ~ A research article containing Covid -19 and TB infection and death rate in Paschim Burdwan in 12 months period (from August 2020 to July 2021) and study of various pollution parameters viz (NOx, COx, SO2, PM 2.5 and PM 10). All data were statistically evaluated. This got pre printed in Research Square platform.
- Swarnaprova Biswas Came 1st in MTIM 2021.
- ◆ Prattusha Khan 1. PhD scholar at IIT Guwahati GATE BT and XL qualified
  - 2. Publications:
    - Molecular and Electronic Structures, Spectra, Electrochemistry and Anti-bacterial Efficacy of Novel Heterocyclic Hydrazones of Phenanthrenequinone and Their Nickel(II) Complexes
    - Dynamics of natural product Lupenone as a potential fusion inhibitor against the spike complex of novel Semliki Forest Virus
  - 3. 2nd PRIZE winner in Oral Presentation in three-day International webinar on the topic "Depression: A Conspiracy of the Microbes" at St. Xavier's College (Autonomous), Kolkata
- Ayush Bagchi has secured an excellent result in GATE-BT; AIR 1, JAM BT AIR 50, GAT B AIR 8, GATE XL AIR 103, TIFR GS Qualified and selected at TIFR Mumbai and NCBS Bangalore, selected for the Campus France Charpak Masters BCS Scholarship, 2022.
- ♦ Upal Chatterjee gave IITJAM BT, GATE XL, GAT B; 2022.
- ♦ Shirsha Mukherjee appeared for IIT JAM AIR 32, GAT B AIR 61; 2022.
- Dibyo Mazumder appeared for IIT JAM-BT AIR 198, GAT-B AIR 70, JGEEBILS, COGJET, GATE XL AIR 136; 2022.
- Liana Mukherjee has made into IISc Bangalore, for M.Sc. in Life Sciences and she ranked AIR 128 in IITJAM, GAT B AIR 34; and she qualified JGEEBILS.

- Mallar Dasgupta has made into IIT, Indore for M.Sc. in Biotechnology; also qualified TIFR, IIT-JAM
  AIR 128, GATE-XL AIR 414, GATE-BT AIR 1522, GAT-B AIR 33.
- Sneha Das 1) Participated in a Workshop on "Introduction to Biotechnology" organized by the Department of Biotechnology at University of Engineering and Management, Kolkata (UEM) on 28<sup>th</sup> June, 2019.
  - 2) Participated in a virtual training on "Chem Draw and Chem Sketch Software Learning" organized by the ACS International Student Chapter and Lavoisier's Association of Shree Guru Gobind Singh Tricentenary University, Delhi-NCR on 28th and 29th January, 2022.

3) Participated in the Poster Presentation Competition at "International Conference on Climate Change: Global Cooperation " organized by St. Xavier's College (Autonomous), Kolkata held on the 26th and 27th of August, 2022.

- Ishita Chanda has got INSPIRE Scholarship Award, given by Ministry of Science and Technology, Indian govt.
- Bartik Saha has got INSPIRE Scholarship Award, given by Ministry of Science and Technology, Indian govt.
- Aritra Ghosh-1) has got INSPIRE Scholarship Award, given by Ministry of Science and Technology, Indian govt

2) Secured 2<sup>nd</sup> position in Junior category of Poster presentation International Conference on Climate Change: Global Cooperation

- Shrijeet Kolley has got INSPIRE Scholarship Award, given by Ministry of Science and Technology, Indian govt
- Sarah Diwan has secured 3<sup>rd</sup> place in Paper Presentation, MTIM 2021; and, has appeared in Air Force Common Admission Test.
- Oishee Janet Sarkar has secured 2<sup>nd</sup> place in Paper Presentation, MTIM 2021.
- ✤ Anwesha Chatterjee -
  - 1. Secured 2nd Position in an Oral Presentation entitled "Schistosomiasis: The Neglected Tropical Disease", in MTIM Chapter XVIII, 2021.
  - 2. Currently working as an Academic Research Analyst in Kolkata.
  - 3. Currently working as HR Executive in an IT Sector.
- Ananya Dutta 1. First class first in M.Sc. throughout in all 4 sems (SGPA- 9.64)

2. Qualified GATE 2022 XL & BT; BT SCORE WAS 562 AND 370

3. Got selected for PhD at IIT Gandhinagar, IIT Delhi and IIT BHU

4.currently working as a jrf at the biomaterials and tissue engineering lab, iit guwahati on " 3d-Bioprinted scaffolds for meniscal Tissue Regeneration".

5.Accepted and in press a book chapter titled " Lantibiotics in anti-fungal therapy-A futuristic approach". which is to be published in Elsevier

6.Accepted and in press a review paper as a part of a book chapter titled- "PCOS current status, Future implications and Phyto-nanomedicine" in Elsevier

# **MODERN TRENDS IN MICROBIOLOGY 2022**

#### PROGRAMME

#### DAY 1: 23<sup>RD</sup> SEPTEMBER 2022

09:00 AM	:	Registration
INAUGRAT	ION	
10:00 AM	:	M.C. introduces audience to MTIM
10:10 AM	:	Prayer & Invocation
10:20 AM	:	Welcoming the Chief Guests & Dignitaries on stage
10:25 AM	:	Felicitation of the Chief Guests & Dignitaries
10:30 AM	:	Inaugural Address by Father Principal, Rev. Dr. Dominic Savio, S.J.,
		addressed by Dr. Sudeshna Shyam Chowdhury
10:35 AM	:	Release of DNA
10:40 AM	:	Vote of thanks for the opening ceremony by Prof. Debjani Dutta

#### TECHNICAL SESSION I

10:45 AM	:	Guest Speaker's lecture – Dr. Subhrojyoti Bhowmick, MD
		SESSION CHAIR - Dr. Kasturi Sarkar
11:30 AM	:	Question & Answer session moderated by Dr. Kasturi Sarkar
11:45 AM	•	Tea break

#### TECHNICAL SESSION II

12:00 PM : Presentations by postgraduates

SESSION CHAIRS - Dr. Jaydip Ghosh and Dr. Madhumita Maitra

(Presentations by postgraduates)

01:30 PM : Lunch break

#### TECHNICAL SESSION III

02:15 PM : Presentations by undergraduates

SESSION CHAIRS - Dr. Sudeshna Shyam Chowdhury and Dr. Mahasweta Mitra Ghosh (Presentations by undergraduates)

03:45 PM		Tea Break
03:45 PM		Inter-College Poster Presentation (In the Big Parlour; Undergraduates & Postgraduates)
		Prof. Lopamudra Roy and Research scholars (Poster Presentation)
04:30 PM		Cultural Programme
06:00 PM	:	End of Day 1
DAY 2: 24tl	h SEP	ГЕМВЕR 2022
10:00 AM	:	M.C. introduces audience to MTIM
TECHNICA	L SES	SION I
10:05 AM	:	Guest Speaker's lecture – Prof. Subrata Majumdar
		SESSION CHAIR - Dr. Satadal Das
10:45 AM	:	Question & Answer session moderated by Dr. Satadal Das
11:00 AM	:	Tea break
TECHNICA	L SES	SION II
11:15 AM	:	Presentations by undergraduates
		SESSION CHAIRS - Dr. Anindita Banerjee and Dr. Riddhi Majumder
01:00 PM	:	Lunch break
TECHNICA	L SES	SION III
01:45 PM	:	Presentations by postgraduates
		SESSION CHAIRS - Dr. Kasturi Sarkar and Prof. Debjani Dutta
03:15 PM	:	Inter-College Poster Presentation (In the Big Parlour; Undergraduates & Postgraduates)
		Prof. Lopamudra Roy and Research scholars (Poster Presentation)
04:00 PM	:	Cultural Programme
05:00 PM	:	Valedictory & Awards
06:00 PM	:	Vote of Thanks by Dr. Arup Kumar Mitra
06:15 PM	:	End of Day 2

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# A BRIEF PROFILE OF DR. SUBHROJYOTI BHOWMICK

#### Dr. Subhrojyoti Bhowmick

Clinical director of academics, medical quality and clinical research at

Peerless Hospital and B.K Roy Research Centre, Kolkata.

#### Education:

- Dr. Subhrojyoti Bhowmick is a medical graduate from Calcutta University with a Gold Medal in Gynecology & Obstetrics.
- He has completed M.D in Pharmacology from IPGME& R, Kolkata and has over 12 years of experience in the field of Clinical Research, Pharmacovigilance and Medication management in Hospitals.
- He has completed PG Diploma in Diabetes and Endocrinology from the Royal College of Physicians, UK.



• He has a certification in Clinical Research Administration & Project Management from Stanford University, USA and in Patient Safety from Johns Hopkins University, USA.

#### Awards and Accolades:

- He has a certification in Clinical Research Administration & Project Management from Stanford University, USA and in Patient Safety from Johns Hopkins University, USA.
- He is the Lead Clinician Surveyor for the American Accreditation Commission International, USA for India.
- He is an Assessor for National Accreditation Board for Hospitals & Health care providers (NABH), India assessing hospitals for medication safety and clinical quality standards.
- He is a qualified NABH Assessor for Ethics Committee Accreditation program in India.
- He serves as the Chairperson, Institutional Ethics Committee of Health Point Hospital, Kolkata and is associated with 2 other Hospital ethics committees as a member.
- He has completed Fellowship in Healthcare Quality from International Society of Quality in Healthcare (ISQua) from Ireland.
- He is the first Indian doctor to be awarded the prestigious Lucian Leape Patient safety fellowship by ISQua for 2019.
- He has been conferred the Honorary Lecturer position at the Institute of Clinical Sciences, University of Birmingham, UK for his contribution to clinical research and healthcare quality.
- He has a considerable experience in training and conducting workshops on Clinical trial methodology, Research Ethics, Evidence based medicine and Biostatistics.
- He has number of publications to his credit and has also authored few chapters on "Regulations governing Clinical Trial" in the book "Fundamentals of Clinical Trial & Research . He has been awarded the U K Seth Oration Award for Best Clinical Pharmacology paper by the Indian Pharmacological Society in 2009.
- He has been awarded as the "Most promising Healthcare professional in Patient Safety" by the Asian African Chamber of Commerce and Industry in October, 2018.
- He has been awarded the Young Quality Achiever award by Consortium of Accredited Healthcare Organizations, India for 2019.
- He has been invited as a Subject expert in Pharmacology in the WHO sponsored MBBS/MD/DM curriculum National review meeting. He is the Editorial Board Member of the prestigious journal "Drug Safety" and peer reviewer for international journals like British Journal of Clinical Pharmacology & CNS Drugs.

- He is a former visiting faculty and examiner for the Clinical Research & Pharmacovigilance certificate course at Jadavpur University, India. He worked at Stanford University School of Medicine, USA as a Senior Clinical Research Associate from 2015 to 2017 and finished certification in Biostatistics; Evidence based Medicine and Medical Writing from Stanford University.
- He worked in the Patient safety and Risk Management Unit of the World Health Organization (WHO),
  Geneva for 3 months as volunteer staff as part of the Lucian Leape Patient safety fellowship award in 2019.
- He was a Visiting Scholar at the Center for Patient Safety Research and Practice, Harvard Medical School, Boston, USA.
- He is a Consultant, Digital Health Programs at MAKAUT, West Bengal, which is the state Technology University. Currently; he is the Clinical Director of Academics, Medical Quality and Clinical Research at Peerless Hospital and B K Roy Research Centre, Kolkata.



# SUBHROJYOTI BHOWMICK

PEERLESS HOSPITAL & B K ROY RESEARCH CENTER

We are pleased to have Dr. Subhrojyoti Bhowmick as our guest speaker for MTIM, who has enlightened us with his deep knowledge on Clinical Microbiology specially on a very interesting topic called 'Clinical trails Of Vaccine'



# A BRIEF PROFILE OF DR. SUBRATA MAJUMDAR

Dr. Subrata Majumdar

Ex- Professor and Ex-Chairman ICMR Emeritus Scientist (Govt. of India) Division of Molecular Medicine Bose Institute Kolkata



Post-Doc Fellow at the University of Pennsylvania 1986-1992

Research Assistant Professor at the University of Pennsylvania 1992-1993

Visiting Scientist at University of Pennsylvania 1999-2000

Honour and Award:

Fellow of National Academy of Science, India 2013

Fellow of West Bengal Academy of Science 2012

Received AFCR National Award, USA 1992

Received Dedicated Scientist Award from The University of Pennsylvania 1992

Received Physician Recognition Award, SMRM, New York, USA 1993

Received Scientific Merit Award from All India Radio. 2017

Honoredas Inaugural speaker In International Immunology Congress at London 2018

President, Indian Society on Tobacco and H+ealth 2013-till date

President, Society of Biological Chemists (India), Kolkata Chapter. 2012-2018

All India Ethical Committee Chairman of Cardiological Society of India

Field of Research:

- 1. Cytokines induced altered signaling mechanism in human neutrophil.
- 2. Signal transduction mechanism during host-pathogen interactions.
- 3. Immunotherapeutic role of chemokines in leishmaniasis and in tuberculosis
- 4. Role of Arsenic in immune system, a major health problem in eastern India.
- 5. Cytotoxic effect of Lipoarabinomannan and other immunomodulators on peripheral blood mononuclear cells during infection.
- 6. Signal transduction Mechanism and Immunological alterations in Leishmaniasis (Kala-Azar), Tuberculosis and Cancer

All the above researches are related to human health for which my lab is highly recognised.

Published more than 160 Papers in International Peer Review Journals including Nature Immunology, JBC, JI, JAC, JID, Infection and Immunity etc.

Trained 31 Ph.D. Students and 17 Post-doctoral fellows at Bose Institute.

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# DIVERSE SIGNALING RESPONSES IN HUMAN MALADIES: KALA-AZAR AND CANCER

#### SUBRATA MAJUMDAR

#### BOSE INSTITUTE

In experimental Visceral leishmaniasis causative protozoan parasite, Leishmaniadonovani invades and multiplies inside the macrophages, one of the sentries of the mammalian immune system. In the present study, we examined the involvement of intracellular ceramide in the host pathogen interaction of BALB/c mouse peritoneal macrophages infected with Leishmania donovani. Our findings indicate that the level of intracellular ceramide was enhanced as a result of the in vitro infection. Enhanced ceramide was also responsible for the downregulation of classical PKC isotypes followed by upregulation of Ca-independent PKC isotypes. Ceramide also impaired the phosphorylation of ERK and JNK. Therefore, ceramide helps the survival of pathogen within the hostile environment. But in cancer, the story of ceramide was different where it helps the process of apoptosis. Here, we observed a marked variation in the expression of PKC a and PKCd isotypes in B16F10 melanoma tumor cells compared to the normal melanocytes. In melanoma cancer the expression or overexpression of PKCa regulates the signalling in such a way that promotes cellular proliferation by activating PLD1 expression and subsequent AKT phosphorylation, which eventually resulted in suppressed ceramide generation and apoptosis. On the other hand, B16F10melanoma tumor preferentially blocked the expression of PKCd isotype, which otherwise could exhibit antagonistic effect on PKCa-PLD1-AKT signalling and rendered B16F10 melanoma cells more sensitive to apoptosis via generating ceramide and subsequently triggering caspase pathway. Here the presentation showed reciprocal PKC isotype signalling operational in both the diseases which regulates ceramide generation and open up a possible clue to target Kala-Azar and cancer by manipulating the PKC isotypes.

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MTIM 2022

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## MTIM 2022

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7. Sylvia Denis & Suhana Sultana



## 1. MISSION TO CURE HIV- "KICK AND KILL" APPROACH FOR HIV LATENT CELLS

## Anirban Das & Archit Bhattacharya

Department of Microbiology, B.Sc, 2nd Year

St. Xavier's College (Autonomous), Kolkata

## **ABSTRACT:**

HUMAN IMMUNODEFICIENCY VIRUS infection and ACQUIRED IMMUNODEFICIENCY SYNDROME is a global problem. Conventional treatments include Antiretroviral drugs but there a number of problems associated with these drugs. Patients have to take life long medications, comply with the strict dosage and most importantly the latent cells with the provirus inside the host cell's genome becomes activated once again and start infection when ART or antiretroviral therapy is interrupted. Moreover these drugs are not a curative approach. A novel approach to target these latent cells and removing them out of the system would potentially lead to a cure. Our focus is on such research work which aims for this "kick and "kill" approach where latent cells will be kicked out of latency by a synthetic latency reversal agent and killed by natural killer cells. The purpose of the experiments conducted on this problem determines if administration of natural killer cells can reduce rebound viremia when antiretroviral therapy is discontinued.

## **KEYWORDS:**

Latency reversal agent, bryostatin, natural killer cells, HIV reservoir.

A novel approach:-

Injection of NKCs and administration of SUW133 which is a latency reversal agent can decrease rebound frequency or delay rebound and hence a kick and kill approach can effectively target HIV reservoir. Hence a combination approach of utilizing latency reversal agents with targeted cellular killing agents can be an effective approach to eradicating the HIV reservoir.

Natural killer cells (NKC) delays viral rebound after ART interruption:-

Two groups of mice were taken and infected with HIV. After that ART was administered. Once they achieved viral suppression, ART was interrupted. One of the groups received an intravenous injection of NKCs while the control group did not.

Results:-

- Treatment group showed a delay in viral rebound. 1 out of 6 mice rebounded earlier but 5 out 6 mice showed rebound after a much later time interval.

- Control group which received no natural killer cells showed at 5 out of 6 mice rebounded earlier.



Figure 1 Assembly of HIV around a macrophage

Natural killer cells reduce viral growth after ART interruption -

Two groups of mice were taken. They were infected with HIV followed by the ART. After achieving viral suppression, ART was interrupted. The control group did not receive any NKCs and the treatment group received NKCs. Viral growth rate kinetics was compared between the two groups.

Results -

- The treatment group showed a 2.1 times decrease in viral growth, that is a slow rate of infection.

The exponential phase of viral growth was focused on. The data shows that natural killer cells target infected cells and hence slow the rate of productive infection of cells that are not infected in vivo.

These two results show that the administration of allogenic human peripheral natural killer cells delay the activation of latent cells and reduces viral growth following interruption of ART.

Latency reversal agents (LRA) and comparison between natural and synthetic LRA:-

Bryostatin 1 is a natural LRA extracted from a marine invertebrate but its bioavailability and in vivo tolerability is low. A synthetic LRA is the need to overcome these problems. SUW133, a Bryostatin analog was developed whose bioavailability and tolerability is better than Bryostatin, also with greater efficiency.

Combined administration of NKC and SUW133:-

3 groups of mice were taken. 1st group received only NKC post ART interruption, 2nd group received only SUW133 and 3rd group received both NKC and SUW133. It was observed that in the first two groups, all the mice rebounded but in the third group, 4 out of ten mice did not rebound at all.

So, this combined approach can potentially target HIV latent cells and transcend our boundaries towards HIV cure.

## **FUTURE PROSPECTS:**

Future prospects include refinement of these approaches and moving into preclinical trials and then into human trials. There is a development of a messenger RNA based vaccine for HIV currently underway. WHO needs to redouble its efforts to reach the 95-95-95 target by 2030 due to disruption of HIV diagnosis and treatment due to COVID19. It means 95 % of HIV positive must be diagnosed, 95% among those receive ART and 95% among those achieve viral suppression.

A paradigm shift towards a more unconventional research for HIV cure is the need of the hour.

## **REFERENCES:**

1. Jocelyn Kim, Tian Hao Zhang et al, Latency reversal plus natural killer cells diminish HIV reservoir in vivo, Nature Communications, USA. (2022)

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## 2. GENE THERAPY: ADVANCES AND PERSPECTIVES IN SICKLE CELL DISEASES

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### **ABSTRACTS:**

Sickle cell disease (SCD) is a well known genetic condition in human beings which has seeked numerous treatment methodologies over the last 50-60 years. Simply put, SCD is a condition wherein the red blood cell in the human body becomes deformed and looks like a C-shaped tool called sickle. Being genetic in nature, there is not much hope of curing the condition through conventional medicine and treatment. However, the last two decades saw a lot of effort and research towards treating SCD through modification of genes in the human body. Formally known as "Gene Therapy", this approach in theory shows a lot of potential towards the treatment of SCD and numerous variants of gene therapeutic treatment are currently in the midst of clinical trials. In this report, we briefly describe SCD from a pathological perspective and try to reason why gene therapy is a better option to treat SCD than standard medical procedures. Moreover, we also investigate some recent gene therapeutic treatments that have shown promising results.

### **KEYWORDS:**

Sickle Cell Anemia, Gene Therapy, Bone marrow transplantation (Allogeneic and Autologous), Blood Transfusion, Hydroxyurea, Lentiviral Vector, CRISPR.

Sickle cell disease is caused by an abnormal HbS ( $\alpha 2\beta$  S 2) in which glutamic acid at position 6 of the  $\beta$ -globin chain of hemoglobin is changed to value. This single base pair mutation has adverse effects on the body. The fundamental event that underlies the complex pathophysiology and multi-systemic consequences of SCD is the polymerization of HbS that occurs under low oxygen tension which alters the structure and function of the red blood cells (RBCs). The outcome is the occlusion of blood vessels in almost every organ of the body and chronic hemolytic anemia, that results in recurrent episodic acute clinical events, of which acute pain the severe form, is also known as "VOC (Vaso-occlusive sickle crisis)" is the most common, and accumulative organ damage.

Before the usage of gene therapy came in there were other ways as well to prevent the adverse effects of SCD. Namely (i)Hydroxyurea, (ii)Blood Transfusion.

### **HYDROXYUREA**

This is the drug treatment for curing or at least for the prevention of the adverse effects of SCD. Hydroxyurea (HU) which has an "anti-sickling" effect via induction of fetal hemoglobin (HbF,  $\alpha 2\gamma 2$ ),increase in HbF dilutes the intracellular HbS concentration, thereby increasing the delay time to HbS polymerization in addition to which, the  $\gamma$ -chains also have an inhibitory effect on the polymerization process. Hydroxyurea, however, is only partially successful because the increase in fetal hemoglobin is uneven and not present in all cells.

## **BLOOD TRANSFUSION**

Parallel to the new medications being developed blood transfusions with normal red blood cells, remain an effective and increasing therapeutic option for managing and preventing SCD complications, but this strategy

has limitations that are, it is not uniformly accessible, accompanied by risks of alloimmunization, hemolytic transfusion reactions and transfusional iron overload.

To overcome mentioned limitations to the prior treatment methodology gene therapy came up as a new way.

## ALLOGENEIC BONE MARROW TRANSPLANTATION

SCD reversal could be achieved W/O complete reversal of hematological phenotype to HbAA. Resulting in BMT as a curative option for **children** with severe SCD. Reversal of the sickle hematology without complete replacement of the patient's bone marrow led to the development of less intense conditioning regimens expanding allogeneic transplantation in adult patients, who otherwise would not be able to tolerate the intense myeloablative conditioning. Donors could be HbAA or HbAS.

In allogeneic transplant, the source of hematopoietic stem cells (HSCs) is from a donor (matched sibling, haploidentical family members, Umbilical cord blood or Matched Unrelated Donor). Allogeneic BMT using HSCs from the latter 3 donor sources are still risky; and donor inavailability presents a huge limitation.

The limitation in the present gene therapy attempt gave rise to AUTOLOGOUS BMT a possibility to overcome the effects of SCD which also gives the future perspectives.

## AUTOLOGOUS BONE MARROW TRANSPLANTATION

With this the patient's own cells could be modified rather than finding a donor and so overcomes the limitation of graft rejection due to an unrelated donor. Under this there are two methods.

## 1. Gene Addition Using LentiViral Vector Based Strategies

Promising Gene addition strategies: Patient's stem cells are infected with a lentivirus expressing an antisickling  $\beta$ -globin variant, T87Q.

Unique feature : Amino acid substitution ( $\beta^{A-T87Q}$ ) allows for HPLC monitoring of the transgene globin levels in the patient's cells. Utilization of lentiviral mediated erythroid specific short hairpin RNA (shRNA) that targets the specific gene for BCL11A and downregulates its expression. A case study for this strategy shows that the patient treated with lentiglobin for SCD after about 15 months of transplantation hasn't shown SCD related clinical treatment and hospitalization.

## 2. Gene Editing: CRISPR- Cas9 Technology

Typically make a double-stranded break (DSB) in a particular genomic sequence directed to that site by a guide RNA. Patient's own BCL11A gene (a major inhibitor of  $\gamma$ -globin gene expression) is disrupted to induce HbF expression. Disrupting the putative binding sites for  $\gamma$ -globin repressors like BCL11A to induce HbF production therapeutic strategy for both  $\beta$ -thalassemic and SCD patients.

**These two methods are now currently in clinical trials.** Though there are successful cases with clinical trials but still these two methods are not yet implemented as treatment methods as though in vitro application is successful but application in vivo yet needs some modifications.

Sure enough the correction to those limitations and implementation of these methods as treatment methods for SCD will open up a whole new possibility for the future.

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## 3. Viral Infection May Enhance Prion Misfolding and Accelerate Neurodegeneration

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## **ABSTRACT:**

Prion Misfolding is always a mystery for scientists all over the world. There are lot of theories regarding the misfolding of Prion Proteins.

In acquired Prion Misfolding, no pathogenic agents other than Prions are found to induce misfolding of Cellular (PrP<sup>C</sup>) into its Amyloidogenic Isoform (PrP<sup>Sc)</sup>. But recently a study hasshown that Influenza A Virus infection can induce Prion Misfolding and promote Neurodegeneration.

## **KEYWORDS:**

PrP<sup>C</sup>/Pr<sup>Sen</sup>, PrP<sup>Sc</sup>/Pr<sup>Res</sup>, Protease K Sensitive, Protease K Resistant, Cellular, Scrapie, IAV, Neuroblastoma Cells, Multiplicity of Infection (MOI), N2a Cells, N2aC24 Cells, Anti IAV Mouse Sera.

## Prions:

Prions are a kind of Glycoproteins that are found abundantly in the plasma membrane of neuronal tissue. It is found adhered to the neuronal issue's plasma membrane via the <u>Glycosylphosphatidylinositol (GPI)</u> anchor.

## Classification:

Prions are classified into 2 types based on their Virulence Activity.

- <u>Protease K Sensitive (Pr<sup>Sen</sup>)</u> [PrP<sup>C</sup>] It is a harmless protein that is found in the mammalian neuronal tissue and is believed to be involved in different biological activities.
- <u>Protease K Resistant (Pr<sup>Res</sup>)</u> [PrP<sup>Sc</sup>] It is a harmful protein which is an Amyloidogenic Isoform of Cellular Prion and is responsible for different Neurodegenerative Disorders like Creutzfeldt-Jacob Disease (CJD), Bovine Spongiform Encephalopathy (Mad Cow Disease) etc.



Fig: Cellular form (PrP<sup>C</sup>) and Scrapie Form (PrP<sup>Sc</sup>)

Prion Misfolding:

- <u>Old Theory</u> : It is believed that no other pathogens other than Prions are responsible for Prion Misfolding. No other form of Pathogen was identified and isolated.
- **<u>Recent Theory</u>** : Recently a theory suggests that Viral Infection (Neurotropic Influenza A Infection)can induce Prion Misfolding and accelerate Neurodegeneration.

Influenza is a virus that belongs to <u>Orthomyxoviridae</u> Family and can be classified as Type A, B, C & D. Among them Type A is responsible for most of the Influenza infections. Every year lots of people get affected and die due to this disease.

Experimental Proofs for Recent Theory:

## i. **Experiment 1 [Preliminary Experiment]:**

To prove the recent theory, a Hit and Run Experiment was done.

Normal Mouse's Neuroblastoma Cells were referred to as N2a Cells which expressed Normal Prion  $(PrP^C)$ Protein. For this experiment, a Transgenic mouse's Neuroblastoma Cells were taken that were referred to as N2aC24 Cells which overexpressed Normal Prion  $(PrP^C)$  Protein 4.1 times of N2a Cells. Neurotropic IAV strains were used to infect the cells at different <u>Multiplicities Of Infection (MOI)</u>.

- 1.0 or 0.1 MOI shows no cell viability
- 0.01 MOI shows very small proportion of cell viability
- After waiting for 7-8 days, Western Blotting was done to identify the Post-Infection Proteins

## **Observation**:

The amount of cell viability, 7-8 days post Infection was found to be very less. To determine the nature of the proteins of the viable cells, a Western Blotting was done which showed that large amount of viable cell proteins are Proteinase K Resistant.

As previously mentioned, nature of PrP<sup>Sc</sup> (Scrapie Form) is Proteinase K Resistant.

This test result indicates that IAV Infection can be the cause of PrP<sup>C</sup> misfolding.



## Fig: Graph comparing between Cell-viabilities at different MOIs

ii. <u>Experiment 2 [Confirmatory Experiment]</u> :

To confirm the above fact, this experiment was done. **Anti IAV Mouse Sera** was used to block the IAV infection and investigation was done for PrP<sup>Sc</sup> by Western Blotting.

## **Observation**:

The PK Resistant cells were undetectable after performing Western Blotting considering 5 Consecutive Samples.

## **Confirmatory Result:**

The above test confirmed that IAV Infection is genuinely responsible for the Conversion of PrP<sup>C</sup> into PrPSc as after the blocking of IAV Infection, no PK Resistant Cells (PrP<sup>Sc</sup>) were detected in the sample. Hence, apart from direct exposure of Infected Prions, Viral Infection is also responsible for Prion Misfolding & accelerating Neurodegeneration.

## **FUTURE PERSPECTIVES & CONCLUSION:**

This experiment proves the connection between Viral Infection and Prion Misfolding. Though a lot of researches have to be done in order to correctly understand their inter-relationship. But this fact is going to be very much helpful in Fatal Neurodegenerative Prion Disease Treatment like:

- Prion Gene Disruption
- Anti-Prion Antibodies etc.

Still there are ongoing researches on this topic to unfold more mysteries of Prion Infections which will be beneficial for future treatment.

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## 4. Biomining and Space : The Future

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## **ABSTRACT:**

Biomining is the process where we use microorganisms to extract lavish metals from their ores with least effect on environment .Microbes play vital roles in Biomining procedure in commercial mining. The bacterial cells are used in the process for chemical reactions directly or indirectly. This Bioleaching/Biomining is one of the applications of biohydrometallurgy. Basically it is the process of conversion of insoluable metal sulfides to water soluble metal sulfates. In recent experiments, microorganisms are employed to mine economically important elements from rocks, including the rare earth elements (REEs), used in alloy production and electronics. Without the presence of gravity the extraction of metals from the rocks.

## **KEYWORDS:**

Biomining, Rare Earth Elements (REE), BioRock

## Microorganisms used & Metals extracted:

• Thiobacillusferrooxidans



• Thiobacillusthiooxidans



These are the generally used microorganisms. Beside these organisms there are few more organisms too like *Bacillus licheniformis*, *Bacillus lutens*, *Bacillussubtillis*. We can extract metals like Iron, Copper, Gold, Silver and Silica from their ores. Besides that, we can extract other important metals like Rare Earth Elements (REE).

## Vanadium Extraction in Space: First Step towards The Future

The Astrobiologists and the team of Biorock researchers tested the hypothesis that the gravity (g) level influenced the efficiency with which biomining could be achieved from basalt, an abundant material on the Moon and Mars, by quantifying bioleaching by three different microorganisms under microgravity, simulated Mars and Earth gravitational conditions. Basically vanadium (v) is more necessary which add to steel to fabricate high strength, transportation, materials for buildings and other applications. The results showed that *Sphingomonasdesiccabilis* and *Bacillus subtilis* enhanced the leaching of vanadium under the three gravity conditions compared to sterile controls by 184.92 to 283.22%, respectively. We know that there is not any significant involvement of gravity on mean leaching, that's why it shows the potential for biomining on Solar System objects with diverse gravitational conditions. Their results demonstrate the potential to use

microorganisms to conduct elemental mining and other bioindustrial processes in space locations with non-1  $\times g$  gravity.

## Reactor Used in this Experiment: The BioRock Reactor

		S. desiccabilis	S. desiccabilis			non-biological control		
REE	Concentration in basalt (µg/g)	Microgravity	Mars gravity	Earth gravity	Microgravity	Mars gravity	Earth gravity	
La	6.81	3.60 ± 1.26	4.96 ± 0.51	3.74 ± 0.51	3.22 ± 2.20	2.56 ± 0.89	1.66 ± 0.23	
Ce	13.53	8.85 ± 2.89	9.26 ± 1.94	7.18 ± 0.99	6.45 ± 3.99	5.79 ± 2.06	4.39 ± 1.26	
Pr	2.32	1.12 ± 0.43	1.67 ± 0.48	1.07 ± 0.11	0.96 ± 0.64	0.85 ± 0.28	$0.48 \pm 0.04$	
Nd	11.57	5.35 ± 2.02	7.89 ± 1.99	5.20 ± 0.47	4.68 ± 3.49	4.28 ± 1.46	2.28 ± 0.24	
Sm	3.04	1.44 ± 0.57	2.03 ± 0.36	1.42 ± 0.12	1.13 ± 0.90	1.06 ± 0.37	$0.54 \pm 0.07$	
Eu	1.13	0.51 ± 0.16	0.66 ± 0.07	0.53 ± 0.04	0.44 ± 0.25	0.42 ± 0.11	$0.27 \pm 0.03$	
Gd	3.67	2.03 ± 0.86	2.93 ± 0.51	2.18 ± 0.13	1.60 ± 1.37	1.36 ± 0.52	0.70 ± 0.10	
Tb	0.57	0.42 ± 0.14	0.57 ± 0.08	0.44 ± 0.01	0.30 ± 0.21	0.26 ± 0.07	0.16 ± 0.02	
Dy	3.92	2.82 ± 1.00	3.99 ± 0.55	3.08 ± 0.21	1.86 ± 1.43	1.58 ± 0.52	0.92 ± 0.11	
Но	0.80	0.69 ± 0.27	0.98 ± 0.08	0.78 ± 0.08	0.45 ± 0.37	0.36 ± 0.13	0.20 ± 0.03	
Er	2.44	2.34 ± 1.01	3.37 ± 0.22	2.75 ± 0.32	1.49 ± 1.26	1.17 ± 0.47	0.64 ± 0.11	
Tm	0.29	0.42 ± 0.16	0.58 ± 0.04	0.49 ± 0.06	0.29 ± 0.19	0.24 ± 0.07	0.16 ± 0.01	
Yb	2.11	2.44 ± 1.09	3.52 ± 0.36	2.83 ± 0.35	1.47 ± 1.19	1.16 ± 0.44	0.67 ± 0.11	
Lu	0.31	0.49 ± 0.20	0.68 ± 0.08	0.57 ± 0.07	0.33 ± 0.22	0.27 ± 0.08	0.18 ± 0.02	

**Table1 :** Content of rare earth elements (REEs; reported as  $\mu g/g$ ; mean  $\pm$  standard deviation) in the basalt substrate used in this experiment and concentrations (total nanograms leached into the chamber fluid volume of 6 mL) at the end of the BioRock experiment in *S*. *desiccabilis* bioleaching chambers and non-biological controls on-board of the International Space Station



**Figure2:** Preflight fluorescence microscopy image of biofilm of *Spingomonasdesiccabilis* growing over and into the surface of a basalt slide as part of Biorock experiment. Organisms are stained with DNA binding dye, Sybr Gold. Growth may be seen into the rock cavities.

**Figure 3:** The BioRock Experimental Unit (EU). (**A**) Top-down image of four Experimental Containers (EC) containing one EU each, showing medium inflated culture chambers. (**B**) Rear side image of the EU showing two basalt slides inserted into the bottom of the culture chambers before closure of EU. (**C**) A lateral cross-section through the culture chamber showing the position of the basalt slide at the back of the chamber and the principle of medium injection and inversion of the membrane (in blue; left side closed, right side inflated with medium). A scale bar shows the size of the unit, which also applies to the images in (**A**) and (**B**). (**D**) ESA Astronaut LucaParmitano inserts an EC into KUBIK incubator on board the ISS (credit: ESA).

#### Body containing medium and faces reservoirs Filed culture chambers





## Microorganisms Used & Medium:

- I. *Sphingomonasdesiccabilis*: It's a Gram-negative, non-spore-forming, non-motile bacterium, which was isolated from soil crusts in the Colorado plateau. In bioleaching, *S. desiccabilis* was demonstrated to preferentially leach heavy (Gd to Lu) rare earth elements (REEs) over light (La to Eu) REEs
- **II.** *Bacillus subtilis*: A Gram-positive, motile, spore- and biofilm-forming bacterium naturally found in a range of environments, including rocks.
- **III.** *Cupriavidusmetallidurans*: A Gram-negative, motile, non-spore forming bacterium. Strains of this species have been isolated from metal-contaminated and rock environments.

## Medium:

The medium used for the BioRock experiment was R2A at 50% v/v of the published component concentrations as it supported growth of all three microorganisms, allowing for comparisons. The composition was (g/L): Yeast extract, 0.25, peptone, 0.25; Casamino acids, 0.25; glucose, 0.25; soluble starch, 0.25; Na-pyruvate, 0.15; K<sub>2</sub>HPO<sub>4</sub>, 0.15; MgSO<sub>4</sub>.7H<sub>2</sub>O, 0.025 at pH 7.2.

## Results:

Data were acquired using the BioRockbiomining reactor, designed for these experiments which contained basaltic rock with known REE composition and major elements. REEs bioleached into solution were measured of all three organisms (*S. desiccabilis, B. subtilis, C. metallidurans*) in all those gravity conditions (microgravity, simulated Mars and Earth gravity) and for non-biological controls. The concentrations of leached REEs in biological and non-biological condition generally followed the trends expected from the abundance in the basaltic rock. Elements with the highest abundance (*e.g.* Ce and Nd) showed the highest leached concentrations while elements with lowest abundance (Tb, Tm and Lu) exhibited the lowest concentrations.

### FUTURE ASPECTS OF BIOMINING IN SPACE RESEARCH:

- **Extraterrestrial Settlements:** We can use biomining process if we colonize planets like Mars and Moon in near future. It will help us to build self-sustaining extraterrestrial settlements.
- **Bioremediation:** There are a number of toxic compounds on The lunar and Martian surfaces that will hamper biomining as well as the settlements. Examples include perchlorates on Mars and toxic lunar dusts Microorganisms performing biomining could also be selected for bioremediation approaches to ameliorate these components by making them less toxic or removing them.
- Asteroid Mining: Asteroids are rich in water, volatiles and carbon compounds, expensive (PGE, gold, silver) and common metals. The major asteroid belt in our solar system alone is very rich in mineral wealth that its value would give each person on earth extends upto \$100 billion. We can extract them by proper instruments in near future with biomining.

## **CONCLUSIONS:**

Now as the goal for space exploration expands toward establishing permanent settlements in other planets, space biomining is generating an increasing interest. The main space agencies have recognized the potential in their roadmaps. Many are the advantages, as terrestrial biomining is considered a sustainable approach in both the economic and environmental terms. Though there will be a problem regarding the quality of ore in space. But we think there will be ample opportunities to learn more about biomining and how it will affect our future space explorations.

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## 5. Involvement of Microbiota in Neural Inflammation leading to Alzheimer's Disease

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## **ABSTRACT:**

Alzheimer's disease is a neurodegenerative disorder which causes serious problems in the brain. Neurons present there are damaged and they die throughout the brain. Also inter-links between networks of neurons may break down, resulting in shrinkage in many regions of the brain. By the final stages of Alzheimer's, this process called brain atrophyis widespread, causing significant loss of brain volume and promote dementia to a major extent. The basic purpose of this paper is to establish the relation between the intestinal microbiota and the brain via the gut brain axis and how dysbiosis in the prior, leads to a severe neurological disease. This paper also aims to focus on potential treatments and scope for research in the future in the same field which have been explained here.

## **KEYWORDS:**

- Alzheimer's disease
- Neurodegenerative disorder
- Brain atrophy
- Cognitive function
- Immunomodulatory
- Amyloid
- Molecular mimicry
- Prion proteins
- FMT i.e. faecal matter transplant

## Gist of the paper:

Gut microbiota is a significant source of amyloids. The best studied is Curli produced by E. coli. Structurally, curli is strikingly similar to pathological and immunomodulatory human amyloids such as amyloid- $\beta$ , which has been implicated in Alzheimer's disease,  $\alpha$ -synuclein, which is involved in Parkinson's disease. This protein helps bacterial cells to bind to each other forming bio films to resist destruction by physical factors.

Exposure to bacterial amyloid proteins in the gut may cause priming of the immune system, consequently enhancing the immune response to production of neuronal amyloid in the brain. Through molecular mimicry bacterial amyloids may act as prion proteins, eliciting cross-seeding, in which one amyloidogenic protein (curli, tau, A $\beta$ ,  $\alpha$ -syn, and prion) causes another to adopt pathogenic  $\beta$ -sheet structure. Both the blood-brain barrier and the gastrointestinal tract epithelium become more porous to small molecules during aging or senescence and as

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a result of which the contribution of gut microbiota in amyloid formation and dissemination becomes even more important.

Involvement of gut microbiota can be understood with the following observations:

Gut cyanobacteria produces amino acid  $\beta$ -*N*-methylamino-L-alanine, a neurotoxin known to elicit excitotoxicity by interacting with the *N*-methyl-D-aspartate glutamate receptor, and *N*-methyl-D-aspartate signalling is known to be disrupted in AD and other neuropathologies. Accordingly, concentrations of  $\beta$ -*N*-methylamino-L-alanine have been found highly elevated in the brains of persons affected by AD.

- > Older adults showed increased abundance of the pro-inflammatory bacteria *Escherichia/Shigella*.
- But individuals showing amyloid deposition evidence on PET imaging exhibited decrease in abundance of the bacteria *Eubacteriumrectale*which is anti-inflammatory in nature.
- AD patients when compared to healthy subject had decreased *Firmicutes*, increased *Bacteroidetes* and decreased *Bifidobacteria* in the microbiome.
- Among *Firmicutes, Lachnospiraceae, Clostridiaceae* and *Ruminococcaceae* are found to be lacking in AD patients which are major SCFAs producers.

## **FUTURE PROSPECTS:**

Potential treatment plans for countering AD is faecal matter transplant. FMT works like this: faecal material is taken from a healthy donor and transplanted to the intestines of the patient. As a result of which the gut microbes of the healthy donor refurbishes the gut microbes of the receiving patient and in turn improves his or her microbial composition and reduces gut dysbiosis.

Experiments are done by researchers with mice who are genetically altered to develop Alzheimer's disease. After receiving FMT from non-antibiotic treated Alzheimer's mice, the antibiotic-treated Alzheimer's mice showed improved gut microbiome and somewhat reduced amyloid plaques in their brains. In two other studies, FMT from healthy mice improved cognitive functions, reduced amyloid beta and decreased other Alzheimer markers in the brains of trans-genetic Alzheimer mice.

More recently, the research team of Hazan et al. conducted a study where an 82-year-old patient with Alzheimer's disease received a faecal transplant from his 85-year-old wife. The gut dysbiosis of the patient was reinstated after two months following the treatment. Also the cognitive function test score of the patient increased from 20 (mild cognitive impairment) to 26 (normal cognitive function), which further improved to score 29 after four months of follow up.

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## 6. Efficacy of Wolbachia-Infected Mosquito Deployments for the Control of Dengue

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## **ABSTRACT:**

Are Aedes aegypti infected with the wMel strain of Wolbachia pipientis less susceptible to dengue virus infection than wild-type Aedes aegypti? A cluster randomized trial to release Aedes aegypti infected with wMel to combat dengue was conducted in Yogyakarta, Indonesia. Twelve geographic clusters were randomly assigned to accommodate the deployment of wMel-infected Aedes aegypti (intervention cluster) and 12 clusters that do not receive deployment (control cluster). All clusters implemented local mosquito control measures as usual. A test-negative design was used to assess the effectiveness of the intervention. They recruited patients aged 3 to 45 years with acute undifferentiated fever. After successful gene transfer of wMel into the intervention cluster, 8144 participants were enrolled. 3721 lived in the intervention cluster and 4423 lived in the control cluster. The protective effect of the intervention was 77.1%, similar for the four dengue virus serotypes. The incidence of VCD hospitalization was lower in participants living in the intervention cluster than in participants living in the control cluster. Therefore, the transfer of wMel into the Aedes aegypti population was effective in reducing the incidence of symptomatic dengue fever and reduced the number of participants with dengue fever.

## **KEYWORDS:**

Dengue, Wolbachia, trial, intervention clusters, efficacy

**GIST:** Dengue is a mosquito-borne viral illness and a big public health problem in most of the tropical world. Up to 100 million dengue cases occur globally every year, with just one mosquito species, i.e., aedes aegypti. In 2019, the WHO designated dengue as one of the top 10 global health threats. Conventional methods to control dengue were by spraying insecticides and reducing breeding sites but despite these efforts the global burden of dengue keeps growing. This intervention (Wolbachia-infected mosquito deployments) takes a different approach, instead of killing mosquitoes they use a naturally occurring insect bacteria called Wolbachia to reduce the ability of *Aedes aegypti* mosquitoes to transmit dengue and other viruses.

In March 2020, the world mosquito program completed, the first, cluster randomized controlled trial of Wolbachia for the control of dengue. The trial was conducted by international research team from the University of Gadjah Mada in Indonesia, Monash University in Australia and university of California-Berkeley in the US and all these happened with the support of Tahija foundation in Indonesia. The results have been published in the **New England Journal of Medicine** which showed that Wolbachia deployments reduced dengue incidents by 77% and dengue hospitalizations by 86%.

Wolbachia pipientis is an intracellular type of bacteria which infects many species of insects but does not occur naturally in *A. aegypti*. Once "virus-blocking" strains of Wolbachia are introduced into *Aedes aegypti* in the laboratory, Wolbachia lives inside the insect cells and is passed from one generation to the next via the eggs. The approach involves regular releases of Wolbachia infected mosquitoes into a wild mosquito population over a period of several months. So, when mosquitoes infected with Wolbachia are released into communities, they mate with wild mosquitoes which spread Wolbachia through the local mosquito population until eventually all mosquitoes carry Wolbachia. Thus, the introgression of "virus-blocking" strains of Wolbachia into field populations of *A. aegypti* is an emerging dengue-control method.

The trial was conducted over three years in Yogyakarta, Indonesia with the aim of, measuring the efficacy of Wolbachia mosquito releases, in reducing dengue incidence. Before starting the trial, they undertook a communications campaign to build strong support for the randomized trial from the local communities and community leaders. The trial site in Yogyakarta city has a population of 312, 000 people in an area of 26 kilometers square, they divided this area into 24 adjacent clusters and randomly allocated 12 to receive Wolbachia deployments. Routine dengue control measures continued across the entire site. Wolbachia-infected mosquitoes were released as eggs into the 12 intervention neighborhoods between March and December 2017 and then stayed at a very high level throughout the study period without the need for reapplication. The spread of Wolbachia into the local mosquito population was monitored through a network of adult mosquito traps. So, how did they measure the efficacy of Wolbachia against dengue? They used a type of case control study called a test negative design. This involved studying patients presenting with acute febrile illness in 18 government primary care clinics throughout the city. Patients aged 3 to 45 years were invited to enroll in the trial, if they were resident in the study area and met other eligibility criteria. The participants' residential address and the locations they had visited for the past 10 days were recorded and a blood sample was collected between January 2018 and March 2020.

The results were as follows- 8144 participants were enrolled. Out of which 385 participants were positive in dengue tests and were classified as virologically confirmed dengue cases, another 5921 were negative in all dengue tests and were classified as test negative controls and the remainder did not meet the criteria for either test positive or test negative illness and were excluded from the analysis. After 27 months, 318 dengue cases were detected in the untreated arm and only 67 in the Wolbachia treated arm, which translates to a 77% reduction in the incidence of dengue in the Wolbachia treated areas of the city. All four dengue virus serotypes were detected among trial participants and efficacy was similar across serotypes. Efficacy against hospitalized dengue was even higher at 86 percent with only 13 hospitalizations for dengue in the Wolbachia treated arm compared to 102 in the untreated arm. That's a particularly exciting result for this trial.

These results show that establishment of Wolbachia in local Aedes aegypti mosquito populations reduces the incidence of Dengue and it works against all four serotypes. Also, this trial highlights the sustainable nature of this method. Wolbachia remains at a high level for more than three years after the completion of releases in Yogyakarta. Following this very positive result, WOLBACHIA releases have now been completed into all areas of Yogyakarta city at the request of the local community and are underway in neighboring districts where two million people live. There's the possibility of a dengue-free Yogyakarta in the coming years. And there's a wider prospect for using Wolbachia to control other diseases like Zika and chikungunya. So finally, it can be hoped that the results of this trial will help Wolbachia to become more widely used by governments in dengue affected countries so that the burden of dengue and other viruses transmitted by Aedes aegypti mosquitoes can be reduced.

## FUTURE PERSPECTIVES:

Future research should examine arbovirus populations for signals of selective pressure associated with Wolbachia. Future studies should explore the multifaceted nature of the intervention, as laboratory studies suggest that wMel could also reduce the transmission of Zika, chikungunya, yellow fever and Mayaro A. aegypti viruses.

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## 7. ORAL AND GUT MICROBIOME AND ITS RELATION WITH RHEUMATOID ARTHRITIS

## ANNETTE ANN FELIX & RUKAIYA GHEEWALA

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## **ABSTRACT:**

This paper aims at introducing the relation between oral and gut microbiome and how it is linked to rheumatoid arthritis. We will demonstrate the pre-clinical stages of arthritis which is characterized by oral dysbiosis, some of which are co related with auto antibody titer. Molecular mechanisms for the involvement of intestinal and oral microbiota in Rheumatoid Arthritis pathogenesis have also been elucidated. We will discuss if the occurrence of synovial citrullinated proteins is a phenomenon specific to Rheumatoid Arthritis. Later, we also throw light on some of the microbiome-based therapeutic management of Rheumatoid Arthritis. The link between gut microbiome and Rheumatoid Arthritis through T cell mediated immunity; TH17/Treg imbalance is also explained. The keystone pathogen, *Porhyromonasgingivalis* acting as an association between periodontitis and Rheumatoid Arthritis.

## **KEYWORDS:**

ACPA, P.Gingivalis, gut and oral dysbiosis, periodontitis and its relation with Rheumatoid Arthritis

## **INTRODUCTION**

The human microbiome is the aggregate of all microbiota that reside in human tissues and fluids. In a healthy body the pathogens and symbionts co-exist and have a mutualistic positive relation with the human body. The human microbiota is made up of the 10-100 trillion symbiotic microbial cells that each individual carries; the majority of these cells are bacteria in the gut. The human microbiome is made up of the genes that these cells carry. The host's health is significantly influenced by the gut flora. Studies on the interactions between microbial communities and the host reveal that these organisms engage in biochemical processes that affect tumour growth, carcinogenesis, and immune treatment response.

## **RHEUMATOID ARTHRITIS**

It is an autoimmune illness that develops when the synovium and its soft tissues are attacked by the immune system. Rheumatoid arthritis is an autoimmune disease that develops when your immune system mistakenly attacks the tissues in your own body. As the illness worsens, the wrists, knees, ankles, elbows, hips, and shoulders frequently begin to exhibit symptoms. Most often, the same joints on both sides of your body will experience symptoms.

In contrast to serum, anti-citrullinated protein antibodies made up a larger percentage of IgG in synovial fluid, which suggested that the antibodies are produced locally in people with rheumatoid arthritis. The gut

microbiome has a role in preserving immunological homeostasis and serves as an indicator of the host's health in conjunction with the gut-associated lymphoid tissue. This relationship can be disturbed, which can lead to numerous inflammatory and autoimmune illnesses as well as have an impact on mucosal immunity and systemic immunity.

Citrullinated protein-specific antibodies are produced at the site of inflammation in people with rheumatoid arthritis and are highly specific for the disease.

We will now examine citrullinated proteins and their function in rheumatoid arthritis to gain a better understanding of the condition.

The process of citrullination involves changing citrulline residues from arginine after translation. Peptidylarginine deiminase (PAD) enzymes found in polymorphonuclear cells mediate it (PMNs). Citrullination only takes place during PMN death when PAD enzymes leak out because calcium ions (Ca2+) are necessary for PAD activation, but the intracellular Ca2+ concentration in normal cells is significantly lower than the threshold Ca2+ concentration required. The ACPA causes osteoclastogenesis and inflammation.

## IS THE PRESENCE OF SYNOVIAL CITRULLINATED PROTEINS A PHENOMENON SPECIFIC TO RHEUMATOID ARTHRITIS?

Citrullinated proteins are a phenomenon connected to inflammation rather than a rheumatoid arthritis (RA) symptom that is present in the inflamed synovium. Autoantibodies directed against citrullinated proteins are specific indicators for rheumatoid arthritis.

## NEUTROPHILS AND NETosis

In patients' with RA, enhanced NET osis was observed in the synovial fluid.

• NETosis is a specialized form of necrosis of neutrophils in which the dying neutrophil forms an extracellular fibril matrix composed of chromatin fibres antimicrobial peptides and enzymes. This acts as a potential new source of autoantigens in genetically susceptible hosts.

## \_Porphyromonasgingivalis and Aggregatibacteractinomycetemcomitans- LEADS TO THE PRODUCTION OF ACPAS.

*Porphyromonasgingivalis* mediates the creation of citrullinated proteins through secretion of gingipains and PPAD. These proteins initiates ACPA formation in genetically predisposed subjects via particular mechanisms and promoted inflammation

- P. gingivalis can cause dysbiosis and inflammation by secreting quorum sensing molecules such gingipains and lipopolysaccharide.
- Dysbiosis in turn triggers inflammation and the cycle goes on
- The epithelial cells secrete the proinflammatory cytokines, which activates neutrophils, promoting enhanced NETosis
- *P. gingivalis* may also be involved in gut dysbiosis due to translocation to the gut.
- Gut dysbiosis, in turn, leads to the production of Th1, Th17 cells and pro inflammatory cytokines which enter the bloodstream and localize in lymphoid tissues. They then activate autoreactive B cells, and produce ACPAs

- Aggregatibacteractinomycetemcomitans also increases ACPA production by B cells in genetically predisposed individuals with its enzyme LtxA.
- *Aggregatibacteractinomycetemcomitans*, led to dysregulated PAD function and release of hyper citrullinated proteins through by inducing neutrophil migration and (NETs) formation

## ORAL MICROBIOME

The T cell-mediated adaptive immunity is predominantly influenced by the oral microbiota. T helper 17 (Th17) cellsobserved in gingival tissue produced against bacterial or fungal infections are associated with joint damage by mechanisms like overproduction of the proinflammatory cytokines. In a study conducted on mice it was confirmed that in collagen-induced arthritis (CIA) in mice the induction of periodontitis by *P. gingivalis* and *Prevotellanigrescens*, resulted in increased presence of Th17 cells in lymph nodes draining arthritic joints.

## **ORAL HEALTH AND ITS RELATION WITH AUTOIMMUNE DISEASES**

Periodontitis, is a chronic inflammatory disorder affecting the periodontium. It has been reported, in fact, that periodontitis patients have twice the chance of contracting RA.

As a result of the antibody reactions against P. gingivalis and particular P. gingivalis virulence factors appearing to correlate with the severity of RA and ACPA levels, *Porphyromonasgingivalis*, a Gram-negative bacterium, is implicated in the relationship between periodontitis and RA.

## CASE STUDY

- In a case study, mice with artificially induced arthritis were infected with wild-type or genetically modified PPAD-deficient P. gingivalis mutants.
- A higher autoantibody production as well as higher joint damage was observed in mice infected with the wild-type strain.
- The proteolytic activity of a specific class proteases secreted by *P. gingivalis*, were necessary for  $\alpha$ -enolase citrullination
- Experiments showed that cleavage of host proteins by gingipains exposes carboxyl-terminal arginine residues, which act as targets of PPAD.

## **GUT MICROBIOME AND RA**

Next, we see the link between gut microbiome and RA through T cell mediated immunity. In healthy individuals, a CD4<sup>+</sup> T cell subtype called regulatory T cells (Tregs) is in balance with Th17 cells, and has an anti-inflammatory role that prevents auto immune responses. Interestingly, a recent study showed decreased levels of Tregs and elevated levels of Th17 cells in the blood of RA patients, proving a TH17/Tregs imbalance. However, the levels of these can be controlled by the gut microbiota through toll like receptors TLR.

## MICROBIOME BASED THERAPAUTIC MANAGEMENT OF RHEUMATOID ARTHRITIS

*P.histicola* supressed arthritis in humanized mice via mucosal regulation and generation of treg cells.

Lactobacillus*paracasei* and *Lactobacillus casei* decrease inflammatory events by selectively degrading proinflammatory cytokines through their protease, lactoceptin.

- A pathogen-induced NET's ability to develop was reduced by Lactobacillus rhamnosus.
- Fecal microbial transplantation (FMT) has also been considered as a potential therapy for rheumatoid arthritis.

## **CONCLUSION:**

The microbiome thus works in harmony with various organs in the body and aids in the proper functioning of a human being. However not much studies have been conducted regarding RA and microbiome mechanism. Additionally, these microorganisms aid in wound healing, immune system bolstering, and the production of volatile signalling molecules necessary for communication throughout the body and the nervous system. Even the gut which houses a large number of microbes need them for proper functioning. Microbes in the gut possess a variety of enzymes dedicated to the digestion of complex carbohydrates and the extraction of nutrients from the food we consume.

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# 8. Gut microbiota mediates intermittent-fasting alleviation of diabetes-induced cognitive impairment

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## **ABSTRACT:**

One of the most common cognitive impairments, known to be the self-reported experience or more frequent confusion or memory loss; Cognitive Decline, is one of the complications of type 2 diabetes (T2D). Intermittent fasting (IF) is a likely looking dietary intervention for heightening up T2D symptoms. However, it's guarding and protective reverberations on diabetes mediated cognitive misadjusting, remains cagey. Here we try to prove by showing that a 28 day IF plan for diabetic mice elevates and improves behavioral impairment facilitated via a microbiota-metabolite-brain axis. IF intensifies positively mitochondrial biogenesis and energy metabolism gene expression in hippocampus, recognizes the gut microbiota and ameliorates microbial metabolites that are associated to cognitive function. Adding to this, very firm connections are seen and observed between IF affected genes, microbiota and metabolites; as seen through by integrative modelling. Getting rid of gut microbiota with antibiotics partly exterminates neo-protective effects of IF. Introduction of 3-indolepropionic acid, serotonin, short chain fatty acid or tauroursodeoxycholic acid portrays a relatively indistinguishable effect to IF with respect to improving cognitive function. Thus, our overall elucidation supports that microbiota-metabolites-brain axis can be used as an orientation that can help go therapeutic strategies in favor against metabolism-implicated cognitive pathophysiologies.

### **KEYWORDS**:

Cognitive impairments, Cognitive Decline, type 2 diabetes (T2D), Intermittent fasting, behavioral impairment, microbiota-metabolite-brain axis, mitochondrial biogenesis, integrative modelling, 3-indolepropionic acid, tauroursodeoxycholic acid, metabolism-implicated cognitive pathophysiologies.

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## 9. Hard drives that are alive – Data storage in DNA

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## **ABSTRACT:**

The digital universe has been growing exponentially in the 21 st century and as a result we are producing a lot more data than we are capable of storing. Everything we do on the internet generates data – from buying any product on Amazon to liking a picture on Instagram. In the field of science and research large amounts of data is generated, which not only needs to be stored carefully but also needs to be easily accessible. Every year the storage necessity is increasing by about 50%. 90% of world's data was generated in the last two years, and an incredible 2.5 quintillion bytes of data was produced daily in 2021. Most of the world's data today is stored on magnetic and optical media. Despite massive improvements in the storage devices, storing zettabytes of data would take many millions of units and use significant physical space. To find alternative solution researchers are looking into nature's hard drives - the DNA- as a storage medium. The DNA in our cells already stores a lot of information – from the colour of our eye to the texture of our hair and so much more. The storage of information in DNA is not much different from that in computers. Data is stored as binary digits of 0's and 1's on a computer whereas in a DNA comprising of adenine, guanine, cytosine and thymine paired in the A–T and G–C fashion, are utilized as binary codes for storing the information. A single nucleotide represents 2 bits of information; as a result, about

455 EB of data can be stored in just 1 g of single stranded DNA. It is said that the data produced by the entire world over a year can be stored only in a mere 4 g of DNA. Digital data can be converted to binary data by specific algorithms and encoded in DNA, which can later be decoded and retrieved at low error rates. The 3-D structure of DNA offers high memory space and makes it a versatile and highly dense rewriteable storage medium. Being extremely dense and durable, with a half-life of about 500 years, DNA-based storage has the potential to be the ultimate archival storage solution.

### **KEYWORDS:**

Data storage, DNA, synthetic DNA, archival storage, molecular computing

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## 10. CRISPR/Cas9 - A new emerging biological tool kit for combating HIV1/AIDS

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## **ABSTRACT:**

In bacteria and some archaea, the clustered regularly interspaced short palindromic repeats (CRISPR) and associated endonuclease (Cas9) perform adaptive immunity against foreign DNA elements. The CRISPR-Cas system has emerged as a useful tool for eukaryotic DNA Genome editing. Pathogenic viruses having a double-stranded DNA (dsDNA) genome can also be targeted with this DNA modification tool. Here, it is examined how CRISPR-Cas has been used in novel therapeutic approaches against human immunodeficiency virus type 1 (HIV-1), focusing on approaches that target and inactivate all viral genomes or prevent viral persistence in latent reservoirs. Current antiretroviral drugs can effectively block HIV replication and prevent transmission, but they do not target the HIV provirus which resides in the cells that make up the viral reservoir. Because the stopping of drug therapy will cause viral rebounds from this reservoir, HIV-infected people face treatment for life. Therefore, new targeted therapeutic strategies are being studied that permanently inactivate proviral DNA and can lead to a cure. Several studies have shown this CRISPR-Cas9 genome editing can be used to target HIV DNA. The approach will therefore be based on how this endonuclease attack can trigger the inactivation of the HIV provirus and how the virus escapes happens and how it can be avoided.

### **KEYWORDS**:

CRISPR-Cas9, HIV-1, proviral DNA, genome editing, latency, viral persistence, antiretroviral drugs, virus escape.

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## 11. Emerging industrial applications of microalgae: challenges and future perspectives

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#### **ABSTRACT:**

Microalgae are unicellular, photosynthetic microorganisms, living in saline or freshwater environments. Microalgae have recently attracted many future interests and found a number of industrial applications in the formulation of food, feed, cosmetics, nutraceuticals, health products, and fertilizers, as well as tools for wastewater treatment and biofuel production. Bioactive compounds such as, protein, polyunsaturated fatty acids, carotenoids, vitamins and minerals, extracted from the microalgal biomass may play important roles in functional food with desirable effects on human health. The success in therapeutic industry is brought about by the production of  $\beta$ -carotene, astaxanthin, polyunsaturated fatty acid (PUFA) such as DHA and EPA and polysaccharides such as  $\beta$ -glucan from micro-algae. However, scaling up and safety issues of the microalgal products still remains a major challenge before commercial competitiveness is attained. Before microalgae become a commercial success in the future, vast research and development efforts are still required. The main goal of this short review is to highlight the industrial applications of microalgae and the challenges faced during commercialization of the products.

#### **KEYWORDS**:

• Microalgae • Functional foods • Nutraceuticals • Pharmaceuticals • Cosmetics

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<sup>•</sup> DHA • EPA.

## 12. THERAPEUTIC STRATEGIES IN COLORECTAL CANCER USING PROGNOSTIC AND PREDICTIVE BIOMARKERS

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## **ABSTRACT:**

Colorectal cancer (CRC) is globally the fourth most common cancer and accounts for almost 10% of all global cancer deaths annually, with the incidence rate on the upswing in India. Although survival in this case is stage dependent with a survival rate of 92% in the first stage, in comparison to 10% survival in stage IV; the treatment strategies involving chemotherapy and immunotherapy have only benefitted a small proportion of the patients. Metastatic cancer is still posing as a huge threat due to poor prognosis, late detection of the disease and treatment failure of the said strategies.

Hence, new non-invasive approaches to help detect CRC at an early stage leading to prognostic stratification are of utmost importance and are gradually being developed. Biomarkers are molecular patterns that can be a potent tool for early cancer detection and personalized CRC treatment. Such biomarkers can be divided into diagnostic, prognostic, or predictive categories. Early diagnostic biomarkers comprise of stool-based DNA assay KRAS, aberrant NDRG4 and BMP3 methylation. Prognostic biomarkers to determine the progression of the disease including early recurrence and mortality include KRAS wherein the mutations cause increased risk recurrent metastatic CRC, BRAF proto-oncogene and CEA, a high molecular weight glycoprotein to predict early recurrence in post operative patients. Predictive biomarkers, on the other hand, are used to personalize treatments according to molecular subtype. These consist of DPD and irinotecan which is a topoisomerase inhibitor of FOLFIRI regimen.

Recent advances in genomics and proteomics of cancer biomarkers have led to the discovery of various prognostic and predictive biomarkers allowing for greater individualization of therapies with more positive outcomes. However, even with different biomarkers at play, there are certain limitations like the unavailability of universal biomarkers to identify patients at risks of invasion, metastasis, or treatment resistance to current therapeutic strategies.

In this study, we have outlined the various protein, DNA and RNA-based biomarkers having the prognostic and predictive properties for CRC by highlighting their advantages, limitations, and future possibilities. Additionally, this paper also outlines the acceptance and management of such treatment methods, illustrating the intricacies of biomarker interactions and the various opportunities of emerging with newer techniques with the help of comprehensive molecular profiling.

## **KEYWORDS**:

Colorectal cancer, Biomarkers, Prognostic biomarkers, Predictive biomarkers, Personalized CRC treatment, Stage-dependent survival, Prognostic stratification.

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## 13. Developing a new class of engineered live bacterial therapeutics to treat human diseases

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### **ABSTRACT:**

Synthetic biology is a field in science that deals with the understanding and studies of fundamentals of molecular biology and metabolic engineering that involves designing of biological circuits or redesigning of existing biological system that be useful in medical field. Live biotherapeutic products (LBPs) are biological tools that contain live organisms and have potential for prevention, cure and treatment of diseases associated to Central Nervous system, gastrointestinal, dermatology, endocrinology, genito-urinary, cardiovascular systemand cancer in human beings. This paper highlights the design, development andpharmacodynamic properties of engineered biotherapeutic tools to reach new heights in the medical science and satisfy the needs of human health.

## **KEYWORDS**:

Live biotherapeutic products, pharmacodynamic, Metabolic engineering.

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## 14. Neuroinflammation and Its Impact on the Pathogenesis of COVID-19

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## ABSTRACT:

A respiratory pathogen called SARS-CoV-2 (Severe Acute Respiratory Syndrome Coronavirus 2) first surfaced in late 2019. Most individuals who have COVID-19 have fever first, and then cough. Myalgia, diarrhoea, and constipation are additional symptoms. Interestingly, coronaviruses are linked to conditions that affect the central nervous system (CNS), including multiple sclerosis, febrile seizures, encephalitis epilepsy, and disseminated encephalomyelitis.

Tight connections between the cerebral, arachnoid, and choroid plexus epithelial cells make up the BBB (Blood Brain Barrier). According to one theory, the virus enters the CNS via connecting to the ACE2 receptor on BBB endothelial cells causing neuroinflammation.

Microglia and astrocytes have been shown to play a key role in neuroinflammation. Microglia, which are the CNS's innate immune cells, become active when the brain is injured or infected.

The SARS-CoV-2 infection may induce the pro-inflammatory microglia phenotype, which might manifest in a patient as a neurodegenerative illness, because microglial cells have such a diverse variety of functions in the CNS. Additionally, the expression of genes that lead to neuroinflammation can be increased when reactive pro-inflammatory microglia are present.

Neuronal damage and neurological alterations that result in Multisystem inflammatory syndrome can be facilitated by SARS-CoV-2 infection. Human brain areas necessary for fine motor control, learning, memory, and emotional responses are impacted by SARS-CoV-2-induced inflammation and hypoxia, and adult hippocampal neurogenesis is lost as a result. Though disturbance of brain vascular integrity, neurotransmission, and neurogenesis, neuroinflammation may have an impact on cognition and behaviour acute effects may persist in COVID-19 survivors with long-COVID symptoms.

## **KEYWORDS:**

Covid-19, neuroinflammation

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# 1. ERYTHRO-VLPS: ANCHORING SARS-COV-2 SPIKE PROTEINS IN ERYTHROCYTE LIPOSOMES

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#### ABSTRACT:

The major conundrum for immune system is to interact with the antigens to elicit active immunity by proper display of antigens. This study utilizes human red blood cell (RBC) membranes for displaying the immunodominant spike proteins of SARS-Cov-2 (COVID-19) virus. Most of the vaccines in vogue introduces the genetic material of the virus coding the spike proteins, either alone or using another viral vector. RBC Liposomes are used as carriers of several biomolecules for a long time but in this study, they were used to display spike proteins on their membrane. A surfactant was used to stabilize the spike proteins's structure in the aqueous environment before insertion and to facilitate reconstitution of the spike proteins in the erythrocyte membrane. Erythrocyte virus-like particles (VLPs) thus prepared were purified on the basis of size, tested for their ability to bind angiotensin converting enzyme 2 (ACE-2) with the surface exposed spike proteins using biolayer interferometry (BLI sensor assay). When immunized to mice models these erythro-VLPs showed seroconversion and a high immunoglobulin (IgG) response without any adjuvant expected from a potent antigen. Erythro-VLPs without spike proteins failed to elicit any immune response. This study thus shows potential of the RBC liposomes in presenting antigens to the immune system in a potent way which can be utilized in many other immunoprophylactic measures even with the mutated variants of spike proteins of COVID-19 virus which are yet to come in existence.

#### **KEYWORDS:**

SARS-Cov-2, Human RBC, ACE-2, Erythrocyte VLPs, BLI sensor, Seroconversion

The pandemic of coronavirus still remains a challenge of the world as a dreadful infection. The causative SARS-Cov-2 virus is transmitted through respiratory droplets infecting the bronchial epithelial cells which trigger a cascade of reactions causing the severity of the disease. It is an enveloped single and positive stranded RNA virus encoding an envelope protein known as the spike (S) protein that binds to the human angiotensin converting enzyme 2 (ACE-2) receptor with high affinity. The densely glycosylated protein also induces both humoral and T-cell response and thus is the target for vaccine development. Several recombinant vaccines are in vogue including vaccine vectors (Astra Zeneca, Covishield) or nucleic acid vaccines (Pfizer, Moderna). The recombinant vaccines require carriers as otherwise the RNA is quickly degraded by cellular processes.

In this paper, the authors demonstrated an alternative approach to administer the immunodominant S-protein using endogenous carriers by in-vitro functionalization of Red Blood Cells (RBCs). They directly anchored the S-protein into the RBC's cytoplasmic membrane as RBCs have been reported to catch immune complexes and present them to antigen presenting cells (APCs). The virus like particles (Erythro-VLPs) thus prepared had been

tested for dose-dependent binding to ACE-2 in biolayer interferometry (BLI) assays as well as to elicit seroconversion in mouse model monitoredby Enzyme-linked immunosorbent assay (ELISA). The binding of ACE-2 of the erythro-VLPs was confirmed through BLI sensor assay. It proved that the correct functional conformation of the S-protein was maintained in a dose-dependent manner while binding to ACE-2 receptors. This observation is consistent with the natural ACE-2 receptor S-protein binding.

The erythro-VLPs vaccinated mice showed antibody response after 10 days as occurs in natural situation and showed a significant increase in the antibody response on days 14 and 28 post vaccination. The increased optical density in ELISA assays was clear evidence for a successful seroconversion. This result shows that the erythro-VLPs can be an effective way to present S-protein to the immune system and this could have substantial therapeutic potential.

RBC mediated presentation of immuno-pathogens is a very effective alternative to any other nano vesicles due to its self-tolerant nature. Another interesting point is that it creates a depot effect which is expected from an adjuvant which enhances the immune responses. Here, a significant amount IgG production was triggered without any adjuvant. Most significantly these natural vesicles can maintain the conformational integrity of the embedded proteins required in proper epitope-paratope interactions. Therefore, the erythrocyte platform may have immense potential in therapeutic uses.

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# 2. TREATMENT OF OVARIAN AND TRIPLE NEGATIVE BREAST CANCERS BY BLOCKING DON'T EAT ME SIGNALCD24.

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#### **ABSTRACT:**

The "Don't Eat Me" Signals are basically proteins that are synthesised and expressed on the surface of the normal working cells of the body, to act as inhibitory signals, preventing the body's macrophages from killing them. They display an antiphagocytic response which keeps the host immune system from accidentally engulfing and destroying the healthy and functional cells. However, recent research has shown that even certain abnormal cells like cancer cells are in a way hijacking this defence mechanism employed by the healthy cells and are using it to their advantage. It has been observed that these cancer cells not only express, but in a way overexpress the production of these "Don't Eat Me" Signals on their surface which in turn help them to evade phagocytosis by the host immune system. They thus effectively remain hidden and get an upper hand in proliferating throughout the body. This type of immune escape has been noted mainly in the cases of Ovarian Cancer, Colorectal Cancer, Hepatocellular Carcinoma, TNBC, etc. Therefore, recent research is aimed at blocking these specific inhibitory signals by the use of monoclonal antibodies so that the host immune system itself can then effectively eradicate the cancer cells by phagocytosis.

#### **KEYWORDS:**

CD 24 (Cluster of Differentiation 24), Don't Eat Me Signal, Siglec-10- CD 24 binding pathway, Immunotherapy, SWA11 Monoclonal antibody.

#### WHAT ARE "DON'T EAT ME" SIGNALS AND THEIR RELATION WITH CANCER CELLS.

The "Don't Eat Me" Signals are "cloaking" proteins are, a defence mechanism which is employed by the healthy cells so that the host immune system only specifically targets and eliminates foreign particles and certain abnormal cells (like cancer cells or cells infected with viruses) if present in the body and in this process does not negatively impact the functional cells. A few noted examples of these types of "Don't Eat Me" Signals include- CD47 (cluster of differentiation) proteins, PDL1 (programmed cell death ligand 1), CD24 (Cluster of Differentiation 24) and B2M (beta-2 microglobulin subunit of the MHC I complex).

These "Don't Eat Me" Signals bind with their specific receptors present on the surface of the macrophages, and NK cells and block their normal phagocytotic response. These receptors of the cloaking proteins are also found to be overexpressed on the surface of these immune cells associated with tumour destruction. For example- The CD24 proteins bind to the Siglec-10 binding receptors present on the surface of macrophages.

#### "DON'T EAT ME" SIGNAL TARGETTED IMMUNOTHERAPY-

This binding of these "Don't Eat Me" Signals with the macrophages triggers a cascade of immune cell inhibitory responses which brings about the overall suppression of the host immunity. Therefore, it was

imperative for scientists to block this signalling pathway, so that the cancer cells could be destroyed by the macrophages. Here, researchers came across the CD24 protein which was regarded as the novel target for cancer treatment.

#### CD24 PROTEIN- A NOVEL "DON'T EAT ME" SIGNAL-

The CD24 (cluster of differentiation 24) is a GPI or Glycosyl Phosphatidyl Inositol anchored protein which has been found to be overexpressed in 2 specific cancers- the Ovarian Cancer and the Triple Negative Breast Cancer, where it has been observed to assist cancer progression in a number of ways- i.e., by inducing tumour cell proliferation, metastasis, and tumour associated angiogenesis in the cancer microenvironment. However, the most detrimental effect was that this protein was observed to impart extra resistance to the tumours against the anti-tumour and chemotherapeutic drugs. This subsequently explained why these 2 particular types of cancer were so difficult to treat combined with a low overall survival rate.

#### **BLOCKING CD24 PROTEINS – NOVEL APPROACH TO CANCER IMMUNOTHERAPY**

In an experiment carried out by researchers, the 6q21 gene band- the gene sequence responsible for coding this CD24 protein was knocked out of a lab grown human breast cancer cell line and the cells obtained after this gene editing procedure were hence found to lack this protein. These cells were them mixed with normal human breast cancer cells which had the CD24 protein expressed on their surface. This mixture of the two types of breast cancer cells were then inoculated with human macrophages in-vitro. The observations showed that the particular cancer cells which lacked the CD24 protein were more readily engulfed by the macrophages than the cell lines which had the protein and which offered resistance to phagocytosis. This experiment hence depicted the obvious role played by the inhibitory signal in evading host immune response. In another subsequent experiment which was carried out, mice were implanted with human breast cancer cells and in them the CD24-Siglec-10 signalling pathway was blocked by the CD-24 blocking antibody by injecting them every 2days with a total of 6 such injections and the results obtained showed a considerable decrease in tumour volume.

#### SWA11 MONOCLONAL ANTIBODY-

After repeated turns of research and experiment, scientists were able to come up with the SWA11 monoclonal antibody preparation which worked towards blocking the CD24 protein. This particular antibody showed promising anti-cancerous properties. It reversed the phosphorylating effects that were brought about by the action of the CD24. The primary effect was to inhibit CD24 action by blocking the signalling with Siglec-10, but apart from this many other accessory effects were also noted. This mAb, when tested in mice with xenografted cancer cells, was seen to halt the uncontrolled division and metastasis of the A549 lung and the SKOV3ip ovarian cancer cells. The tumour microenvironment was altered with rise in the levels of the chemo-attractants, which in turn increased the invasion of the cancer cells by macrophages leading to their rapid phagocytosis. The cytokine levels in the tumour microenvironment were also seen to be increased in both cases



of the A549 and SKOV3ip cells, along with rapid activation of the ADCC and complement system.

The graphs shown here depict that following the administration of SWA11 mAb, tumour volume and weight decreased along with a considerable reduction in

the percentage of positive cancer cells, as compared to the corresponding immunoglobulin control. Therefore, all these combined effects of the SWA11 mAb reportedly made the chemotherapeutically resistant cancer cells sensitive to phagocytosis as well as to chemotherapy. Hence, it was suggested to use this antibody preparation along with chemotherapy drugs like Gemcitabine.

### **FUTURE PROSPECTS:**

The anti-CD24 monoclonal antibody preparation, despite its utility and efficacy, has got certain aspects of toxicity related with its use. These areas need further research to rule out the chances of side-effects. Ovarian and triple negative breast cancer cells thus seem to use the CD24 proteins to escape host immune response.CD24 can be thus be regarded to be a marker as well a novel immunotherapeutic target in the case of these particular cancers. Future prospects of these "Don't Eat Me" signal targeted immunotherapy hopes to implement the use of antibodies aimed at blocking multiple inhibitory proteins whereby custom-made therapy can be designed for each patient.

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# 3. IS GARLIC ANTIBACTERIAL AND ITS ROLE IN FIGHTING AGAINST COVID-19

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#### **ABSTRACT:**

This experiment mainly focuses on how garlic (Allium sativum) works against bacteria and how it is efficient in helping to prevent SARS-CoV-2 infection. The major active components of garlic are its organosulfur compounds. Allicin (diallylthiosulfnate) is a defence molecule from garlic (Allium sativum) with extensive antimicrobial activities against Gram-positive and Gram -negative bacteria, including antibiotic resistant strains, and fungi. When performed by the Institute of Standards and Industrial Research Iran then it was found that garlic successfully controlled or prevented the growth of S. aureus bacteria in hamburger samples that were taken.

On a similar note it was also found that the consumption of functional foods prepared by encapsulated/ free bioactive compounds of garlic may have a key role in the incidence decrease of COVID-19 in different communities. This is enabled by the formation of hydrogen bonds between the serine type protease and garlic bioactivities in the active site regions inhibit the covid-19 outbreak.

#### GIST

#### **BENEFITS OF GARLIC**

The garlic extract complements reduced high cholesterol levels, and also blood pressure in the patients with hypertension. In women, Estrogen is the hormone that maintains garlic helps is maintaining. Menopausal women tend to produce low estrogen, which stimulates on weakening of the bones.

#### **EXPERIMENT PERFORMED**

Materials and Methods:

In this study, the garlic aqueous extract was prepared under sterile conditions and was added in 1, 2, and 3 mL to 100g hamburger samples. A group of samples was prepared to be used as treatment sample, while a group was stored at 4°C and -18°C. The samples were kept in refrigerator for one and two weeks and they were frozen for one, two and three months and then exposed to microbial tests.

#### **RESULTS**

Statistical estimation of the first and second week samples indicated a substantial growth decreased by all the 1, 2, and 3-mL extracts. In treatment of one, two and three-month samples, the growth of S. aureus was significantly reduced by the 1ml, 2ml and 3-mL extracts. In the treatment for 1 month the 1-mL extract was not as operative in decreasing the growth, and a significant variance was detected in treatments with 2 and 3-mL extracts.

### HOW ALLICIN WORKS AGAINST BACTERIA

Allicin (diallylthiosulfnate) is a defence molecule from garlic (Allium sativum) with extensive antimicrobial activities against Gram-positive and Gram -negative bacteria, including antibiotic resistant strains, and fungi. In addition being redox active, allicin is also relatively lipophilic. The calculated logP value of allicin is 1.35, demonstrating that allicin is membrane permeable and its antimicrobial activity is certainly facilitated by its ready entry into cells. Though, allicin and its derivatives have been discussed as primary compounds for new antibiotics. The capability of allicin to inhibit various sulfhydryl enzymes specifies that the mechanism of antibacterial action of allicin is by reacting with the sulfhydryl groups of the many metabolically vital for bacterial enzymes.

#### **GARLIC AGAINST COVID 19**

The existing foremost health crisis in the world is coronavirus disease. The enhancement of nutritional pattern is a successful approach to combat this major pandemic. Hence one of the most effective naturally occurring antibiotics against the wide range of viruses and bacteria is garlic.

The entry of genetic material into the host cell is the critical event in the life cycle of all viruses. The spike proteins which cover the Sars Cov 2 virus facilitates this event and attaches to the host cell surface receptor. The virus entry into the cell is promoted by a type 2 serine proteases located on the host cell membrane. Thus the inhibition of covid-19 outbreak is brought about by the formation of hydrogen bonds between serine type protease 1 garlic bioactives in the active site region.

The structure of main protease of SARS-Cov 2 comprises of a serine type Mpro (chymotrypsin like protease (3CL pro)) protease with a kind of amino acids such as (such as Thr24, Thr26 and Asn119) present in active site regions(eg 6LU7 and 2GTB). Mpro has significant structural similarity between types 1 and 2 of SARS Cov 2. Since this protease is liable for the viral replication and the synthesis functional protein as a outcome of the proteolytic maturation of SARS-CoV-2, the infection rate may be substantially reduced by hindering the cleavage of the viral polyprotein . The inhibitory effect of garlic against SARS-CoV-2, seven OSCs of alliin, S-(allyl/ methyl/ethyl/propyl)-cysteine, S-propyl L-cysteine, and S-ally-mercapto-cysteine were considered as probable constitutes to inhibit the Mpro of SARS-CoV-2 through H-bonds with this protease. Molecular docking investigation showed that alliin among other OSCs has higher anti-viral potential to stop COVID-19.

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# 4. Human Cytomegalovirus (HCMV) – A threat to the transplant patients

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#### **ABSTRACT:**

Human cytomegalovirus causes a lot of infections in people with problem of immune system or having congenital problems. There are antivirals which target the viral polymerase but it also causes cross resistance and toxicity. There is an urgent need of antiviruses targeting other replication processes and causing less harmful effects. During HCMV replication, terminase complex cleaves and packages the DNA into capsid. They are the best targets for highly specific antivirals. They are found in herpes virus and bacteriophages but not in mammalian cells. Letermovir was found to be effective against herpes virus in phase 3 trials but no one could understand the mechanism. It had no significant body against herpes virus and non human CMV.

It causes diseases in liver, lungs, pancreas, digestive system, heart, blood etc. No special drug is discovered to cure it completely. That's why GCV, VGCV, CDV, FOS are used. Attempts are recently made to develop anti HCMV compounds.

#### **KEYWORDS:**

Cytomegalovirus; DNA packaging; Terminase; Letermovir, GCV, VGCV, CDV, FOS

#### INTRODUCTION:

HCMV is a ubiquitous herpes virus. It belongs to the beta herpesviruses group, The seropositivity in the population ranges from 40% to >90%. It has a double-stranded DNA genome of approximately 230 kb. This genome encodes over 200 proteins. It has high species specificity, various cellular targets and slow replication in cell.

#### IT'S EFFECTS ON HUMAN BODY AND TRANSMISSION FROM ONE PERSON TO ANOTHER:

It doesn't generally cause long term problems in healthy individuals with proper immune system. It causes asymptomatic infections. It also causes some febrile illness like cold or mononucleosis with sore throat, swollen lymph nodes, fatigue, and fever. Viremia is rapidly controlled by cell-mediated immunity, but HCMV establishes life-long latency in many cells. After infection CMV stays inactive in the body for a long time. It doesn't reproduce actively. So it remains asymptomatic. But when the patient becomes sick or his/her immune system is compromised, it becomes active again. It is harmful for people having organ transplants, bone marrow transplant or stem cell transplant as they get easily affected by HCMV.

HCMV infection spreads from one person to another when a person comes into direct contact with an infected person's bodily fluids like, blood, urine, saliva, semen, tears, and breastmilk. Many people are first infected with CMV during childhood. A pregnant mother can also transmit CMV to her unborn child. Sometimes a

transplant patient can also get infected by CMV because of transplanted organ, bone marrow, or stem cells, or from blood or white blood cell transfusions given when they are sick.

#### THREATS OF HCMV:

A transplant patient takes immunosuppressive drug (cyclosporine or tacrolimus, azathioprine, prednisolone, antilymphocyte antibody preparations) to suppress the immune system which prevents rejection of donated tissue. The Suppressed Immune system helps HCMV, along with some fungal element to enter. This causes graft vs. Host disease. An active CMV infection can cause major health problems like Liver disease (hepatitis), Lung infection (pneumonia), Infection of the pancreas (pancreatitis), Digestive disease (colitis), Infection of the brain or spinal cord (meningitis or encephalitis),Heart infection (myocarditis),Blood clots in vein (venous thrombosis), Bacterial infection of the blood (bacteraemia) etc. Active CMV infection also results in organ rejection. Sometimes it also causes death.

#### **PREVENTION:**

HCMV can be prevented by prophylaxis and by pre-emptive treatment. Prophylaxis is the administration of antiviral drugs to all patients (universal prophylaxis) or to a subgroup of patients at higher risk of viral replication (specific prophylaxis) for a predetermined period of time in cases with an increased occurrence of viral replication after transplantation. On the other hand, the early diagnosis of viral replication, before the development of the disease is the pre- emptive treatment. This diagnosis is done through regular laboratory monitoring for the detection of viral replication. The use of the antigenemia assay and the polymerase chain reaction can quantitate viral load during infection or disease. It also provides a useful marker of response to therapy.

#### **FUTURE PROSPECTS:**

Medicines can help to control the contagion, greatly lower the chance of getting an active CMV infection. But they cannot make one fully contagionfree. The only medicines certified for the treatment of HCMV infection and complaint are Ganciclovir( GCV, CymeveneR), Valganciclovir( VGCV, ValcyteR), Cidofovir( CDV, VistideR) and Foscarnet(FOS, FoscavirR). All of them target the viral polymerase pUL54. These antivirals have cure- limiting toxin and resistances emergence. Recent attempts to develop newanti-HCMV composites have concentrated substantially on new targets similar as the viral kinase UL97 (Maribavir) and the viral Terminase complex involved in viral DNA fractionalization/ packaging. New antivirals targeting other replication way and converting smaller adverse goods are given emphasis. During HCMV replication, DNA development and packaging are performed by the Terminase complex, which cleaves DNA to package the genome into the capsid. These Terminase proteins are ideal targets for largely specific antivirals. A new Terminase asset, antiviral Letermovir, lately proved effective against HCMV in phase III clinical trials, but the medium of its action isn't yet known. Letermovir has no significant exertion against other herpesvirus ornonhuman CMV. HCMV terminase complex includes a large (pUL56) and a small(pUL89), On the other hand, proteins pUL51, pUL52, pUL77 and pUL93 feel to be part of the Terminase complex. It shares in the DNA fractionalization/ packaging process. Several motes targeting Terminase proteins have been discovered (2bromobenzimidazole(BDCRB), GW275175X and BAY 38-4766) but those could not reach phase 2 or 3 clinical development. A recombinant glycoprotein B(gb) vaccine has shown some efficacy in precluding the infection in youthful women, adolescent and seronegative organ transplant cases. Also, pp65 and ppUL83 is shown to reduce viremia in maemophilic stem cell transplant cases. Two vaccine strains were downgraded for vaccination- announcement- 169 and Towne. The Towne downgraded strain went on to expansive testing on donors of order transplants who were administered with the Towne downgraded strain contagion and shown to be largely defended against serious CMV complaint and rejection of the graft.

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# 5. Modulation of aroma and chemical composition of Albariño semi-synthetic wines by non-wine *Saccharomyces* yeasts and bottle aging

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#### **ABSTRACT:**

Different strains of *Saccharomyces* yeast fermented in semi-synthetic must containing cv. Albariño aroma precursor and precursors to polyfunctional mercaptans. The end product wines underwent accelerated anoxic ageing. After that, several gas chromatography techniques were used to examine the scent profiles.

Compared to *Saccharomyces cerevisiae*, cryotolerant strains demonstrated improved fermentation capabilities with substantial differences in volatile and non-volatile fermentation products (S. *cerevisiae*). We hypothesised that higher flux across the GABA shunt may be responsible for Saccharomyces uvarum (S. uvarum) strains' highest amounts of  $\gamma$ -butyrolactone and diethyl succinate. These strains also produced the most geraniol, branched-chain ethyl esters, and  $\beta$ -phenylethyl acetate. S. *kudriavzevii* strains showed a momentous capacity to deliver polyfunctional mercaptans, with SK1 strain yielding up to 47-overlap and 8-overlay more 4-methyl-4-mercaptopentan-2-one (4MMP) than S. cerevisiae and S. uvarum strains, individually. The wild S. cerevisiae lager detach showed a specific smell profile because of the greatest creation of ethyl 4-methylval-erate (lactic and fruity notes),  $\gamma$ -octalactone (coconut), and furfurylthiol (broiled espresso).

#### **KEYWORDS:**

Saccharomyces uvarum; Saccharomyces kudriavzevii; Polyfunctional mercaptans; 2-furfurylthiol; 4MMP; GABA shunt

#### **INTRODUCTION**

White wine's scent plays a key role in determining both its quality and varietal identity. It is formed as a result of the aromatic metabolites produced during fermentation. Terpenes, C13-norisoprenoids, and polyfunctional mercaptans were discovered to be the most significant family of varietal aroma chemicals (also known as thiols). These varietal smells in grape musts can be found in a free (i.e., volatile) state or a non-volatile state when coupled to a non-volatile varietal pre-cursor. On one hand, acid-catalysed hydrolysis takes place throughout the winemaking process and contributes to the release of bound-aromas. On the other hand, S.cerevisiae, the primary species employed in winemaking, can also perform enzymatic hydrolysis of bound aroma molecules to a lesser level.

#### **METHODS**

#### 1. Analysis of main metabolites

Using the methodology, HPLC (High-Performance Liquid Chromatography) was used to measure the concentrations of ethanol (percent v/v), glycerol (g/L), erythritol (g/L), succinic, citric, and malic acid (g/L), glucose (g/L), and fructose (g/L) in the finished wines and throughout fermentation. The pH levels of the finished wines were also measured.

#### 2. Determination of volatile aromatic compounds in young and aged wines samples

Higher alcohols, volatile fatty acids, and significant esters, which are often present in quantities over 0.2 mg/L, were only acquired in young samples (immediately after fermentation) and examined by GC-FID (Gas Chromatography with flame ionisation detector). Analysis of Polyfunctional mercaptans was done.

#### **RESULTS:**

#### 1. Fermentation activity and main metabolites produced

In less than 14 days, all fermentations carried out at 16 °C reached trace sugars satisfactorily. Cryotolerant yeast strains (squares and diamonds) generally consumed hexose sugars more quickly than S. *cerevisiae* strains, as shown in Fig. 1A and B. (circles). For instance, S. *kudriavzevii* strain SK1 was the fastest at consuming fructose in addition to glucose. Regarding cell growth, the two S. *uvarum strains* produced the most biomass (Fig. 1C). On the other hand, the S. *cerevisiae* strain SC2 mainly displayed slow fructose consumption from the beginning of fermentation, which led to a low fermentation and a slow biomass production (Fig. 1B and C).



#### 2. General effect of yeast strain and aging on Albariño wine and must aromas

In young wines and musts, sixty volatile chemicals were identified and divided into ten groups: volatile acids, higher alcohols, acetate esters, ethyl esters, miscellaneous and carbonyl compounds, phenols, lactones, C13-norisoprenoids, mono-terpenes, and polyfunctional mercaptans.

#### A. Aromatic diversity in young Albariño wines according to yeast strains

The yeasts were divided into three groups by the hierarchical cluster analysis used on the fragrance concentration data sets of young wines. The SC2 strain was present alone, and the two S. *uvarum* strains were grouped together. The strains T73, MSB, SK1, SK3, and SC1 were together. Within this final group, S. cerevisiae wine strains (T73 and MSB) and environmental S. *kudriavzevii* strains were sub-grouped according

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to species (SK1 and SK3). When compared to T73, SC1, SK1, and SK3, SC1 was shared several characteristics, such as a high R-limonene level that was 13-fold higher than that seen in the young must.

#### B. Aromatic diversity of aged Albariño wines according to yeast strains

Similar to young wines, three groups of yeasts were identified using hierarchical cluster analysis on the aromas of aged wines. The S. *uvarum* strains BMV58 and SU1 continued to group together, primarily due to their highest levels of most esters, with the exception of ethyl cinnamate, which was not found.

#### DISCUSSION

Albariño grapevine is a cultivar that acts as a very important storehouse for varietal aromas and some recent studies have determined the influence of different yeast strains and bottle ageing on the production of several volatile compounds. In this study, we determine the modulation of a variety of Albariño aromas based on different strains of yeasts like wild S. *cerevisiae*, cryotolerant S. *uvarum* and S. *kudriavzevii* and maturation of aroma during bottle ageing.

#### 1. Aroma modulation by S. uvarum strains

S. *uvarum* strains have an excellent capacity of releasing  $\gamma$ -butyrolactone and diethyl succinate. The biosynthetic origin of such compounds can be related to the catabolic pathway of glutamate or the GABA shunt. Succinate is the end product of the GABA shunt which gives diethyl succinate after double esterification with ethanol. Significant amount of higher alcohols, ethyl esters and acetates involved in the catabolism of branched-chain and aromatic amino acids were also found in young and aged wines fermented by this strain. It was also seen that S. uvarum strains grew faster than the rest, SC2 being the slowest. Young wines of these strains exhibited highest levels of geraniol. This particular strain also exhibits a high capacity to release various PFMs.

2. <u>SC2 strain – a particular strain.</u>

SC2 is the only strain that produced ethyl 4-methylvalerate which is an isomer of ethyl hexanoate but with a very low odour threshold resulting in the strawberry aroma. Lactones in wine have a very effective role but their synthesis by yeasts is yet to be fully discovered. However, two metabolic pathways have been observed that could produce  $\gamma$ -octalactone : a) yeast lipid metabolism and b) hypothetical pathway involving acrylic acid. High content of furfurylthiol is seen which is a key volatile thiol with a strong roast coffee aroma.

3. The capacity of S. kudriavzevii strains in releasing polyfuntional mercaptans.

The large amount of polyfunctional mercaptans (4MMP and 3MH) found in the young wines of S. *kudriavzevii* have very potent aroma molecules that give tropical notes, even at low concentration. Protein Irc7p is mainly responsible for the production of 4MMP.

#### **CONCLUSION:**

A notable impact of yeast strain and ageing on the modulation of Albariño aroma profiles were seen in young and aged wines obtained from S. *uvarum*, SC2 and S. *kudriavzevii* strains. The S. *uvarum* strain has contributed to the highest synthesis  $\gamma$ -butyrolactone and diethyl succinate. The best fermentative performance was seen in S. *kudriavzevii* stains that also showed great efficiency to release PFMs. The wild S. cerevisiae SC2 strainexhibited highest production of furfurylthiol and erythritol. Finally, ageing favored the increase of various aromatic compounds, among which the 'aged wines of S. *uvarum*' was very significant due to their higher content of branched esters with fruity notes.

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# **FUTURE PERSPECTIVES:**

Yeast strains other than S. *cerevisiae* have drawn attention in wine research for their capacity to create compounds like fusel alcohols and esters, at higher concentrations. Additionally, they might enhance the release of a greater volume of bound varietal aromas, giving wines richer flavour profiles.

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# 6. PARKINSON'S DISEASE IN RELATION TO GUT MICROBIOTA

# 🛶 🖉 Debadrita Roy & Ritojo Basu

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### **ABSTRACT:**

The purpose of the experiment is to discover the relationship between PARKINSON'S DISEASE (PD) and the GUT FLORA and to prove that the GUT MICROBIOTA is the important modulator of the neurodegenerative disease –PARKINSON'S DISEASE. This study also includes the gastrointestinal symptoms and alterations of the ENTERIC NERVOUS SYSTEM (ENS) which often precedes the parkinson's disease. This study also focuses on the fact that PD related GUT microbiota dysbiosismight lead to impairment of Short-chain fatty acids (SCFAs) producing process, lipid metabolism, immunoregulatory function and intestinal permeability, which contributes to the pathogenesis of PD. It also focuses on several new approaches used in treatment of PD like fetal cell transplantation, use of stem cells and gene therapy.

#### **KEYWORDS:**

GUT;PARKINSON'S DISEASE(PD);MICROBIOTA;ENTERIC NERVOUS SYSTEM (ENS); SHORT-CHAIN FATTY ACIDS(SCFAs);GUT- MICROBIOTA DYSBIOSIS;INTESTINAL PERMEABLITY; FETAL CELL TRANSPLANTATION; STEM CELL; GENE THERAPY.

PARKINSON'S DISEASE is a progressive neurological disorder that affects physical movements in humans; mainly it is caused due to loss of a nerve cell in the substantia nigra of brain. Clumped LEWY BODIES (LBs) in brain also causes PD. PD results in trembling of hands, legs, jaw and face, stiffness of arms, trunks, legs, slowness of movements, poor balance, speech difficulty.

An altered microbiome is mainly responsible for contributing towards PD pathology. For example, in a mouse model of PD which had an infected microbiome (taken from a PD patient) showed overexpression of alpha-synuclein and its accumulation which is a pathological hallmark of PD. But the same mice raised in a germ- free environment with no bacteria in their gut, showed no symptoms of PD.

Ghrelin, a neuropeptide which mainly stimulates appetite is found in low levels in PD patients and this ghrelin level in blood depends on gut microbiome. An altered gut microbiotadue to Parkinsonism, increases the ability of molecule to permeate the intestinal walland may lead to translocation of these molecules, thereby it may also allow neurotoxin to enter gut. Similarly it also releases proinflammatorymolecules like TNF-alpha and interferon gamma which enters the brain and contributes towards PD pathology.

A gut microbiota composition is largely affected by a person's age, diet, and their smoking habits. In elderly people there are less SCFAs producing bacteria in their gut microbiome, which has a neuroprotective effect thus helping in prevention of PD. So, there are higher chances of elderly people getting affected with PD.

It was found that risk of developing Parkinsonism was 60% lower among cigarette smokers than among never smokers and 30% lower among coffee drinkers than among non-drinkers. The consumption of coffee mainly

increases the number of Bifidobacteria, which has anti-inflammatory properties. Additionally, coffee and tobacco promotes bacteria that counteracts certain forms of chronic GI infection, mainly caused by *Helicobacter pylori*, the presence of which is associated with increased risk of PD. Both cigarette and coffee consumption can alter the GUT microbiota composition in a way that could lead to less misfolding of alpha-synuclein in the ENS, thus reducing the risk of PD by minimizing the propagation of protein to the CNS.

Caffeine also reduces the risk of development of PD by antagonizing A2A receptors and stimulating the D2 receptors (present within the dopaminergic neurons) which leads to increased motor activity and motor symptoms improvement.

Tea has a range of natural products within it like polyphenols, methylxanthine, caffeine which reduces the risk of PD. Epigallocatechingallate(EGCG), a polyphenol, provides neuroprotection by inhibiting production of free-radicals and pro-inflammatory markers within the brain, Theanineincreases dopamine levels in brain which helps in the proper coordination of body movements, flavinoids helps in increased blood flow to the brain by their anti-inflammatory effects on the circulatory system and helps to reduce the risk of developing Parkinson's Disease.

Consumption of milk has been associated with 17% increase in the risk of developing PDfor every 200g/day increment in milk intake. High consumption of milk leads to low serum uric acid levels due to effect of casein on uric acid concentrations. But high serum uric acid levels reduce the risk of PD and also the duration of the disease.

Depending on the subtype of fat consumed, there is a inverse relationship between PD risk and dietary fat consumption. N-3 POLYUNSATURATED FATTY ACIDS (PUFAs) reduces PD risk. Located in the neuronal membranes, abundance of PUFAs within brain provides a neuroprotective effect while its deficiency leads to poor brain function.

Infection with microbes like *Mycobacterium aviumparatuberculosis*(MAP) and *Helicobacter pylori*(HP)increases the risk of PD development. HP infection predisposes to autoimmunity, that results in neuronal damage and eventual Parkinsonism. HP infection increases the risk of PD by 45%. After infection by MAP, there is gradual protein aggregation associated with lewy bodies' formation which is mainly due to iron toxicity from MAP spheroplasts or consumption exhaustion of the processes that both maintain cellular protein homeostasis and intracellular removal of pathogens.

Fecal microbiota from PD patients shows higher levels of pro-inflammatory Gram-negative bacteria from the Ralstonia Genus along with increased levels of *Eubacterium eligens* and *Eubacterium hallie*, corresponding to a worsened disease state. The increase in Enterobacteriaceae family in fecal microbiota of PD patients is mainly linked with worsening postural instability and gait disturbances.

The beneficial and anti-inflammatory Gram-negative bacteria, Prevotella were reduced in feces of PD patients. This bacterium is important in the degradation of complex carbohydrates to produce SCFAs along with folate and thiamine as its byproducts which helps to promote a healthy microbial environment. Reduced levels of Prevotella leads to reduction of music proteins leading to increased intestinal permeability, a sign associated with PD.

Medications like LEVODOPA- a dopamine precursor which helps to increase dopamine levels in brain and manage PD. Catechol-o-methyl transferase(COMT) inhibitors also helps to manage PD by inhibiting the

catechol-o-methyl transferase enzyme which degrades the neurotransmitters. Dopamine agonists like PRAMIPEXOLE activates dopamine receptors and helps to manage the disease. The MAO-B inhibitors like selegiline, safinamide increases the amount of dopamine in the basal ganglia and helps to manage the PD.

Some new approaches are also used in the treatment of PARKINSON'S DISEASE like neural growth factor, deep brain stimulation, stem cell transplantation, fetal cell transplantation, restricting the propagation of alpha-synuclein by using antibodies to target and degrade the extracellular alpha-synucleinand prevent it from infecting neighbouring cells.

The relationship between PARKINSON'S DISEASE and the GUT flora had paved a new way for treatment of various diseases including various new approaches for the early diagnosis and treatment of PD. It has provided a solution on how to use microorganisms living in the GUT to treat various complicated diseases. If we are able to isolate and develop a sterile environment that mimics the human gut, then creating solutions for many convoluted disease will become apparent. These contemporary treatments will be much more efficient and accessible to patients since we will be able to harvest the microorganisms easily, with no side effects.

A better understanding of the brain-gut-microbiota axis interactions should bring a new insight in the pathophysiology of PD and permit an earlier diagnosis with a focus on peripheral biomarkers within the ENS. Novel therapeutic options aimed at modifying the GUT microbiota composition and enhancing the intestinal epithelial barrier integrity in PD patients could influence the initial step of the following cascade of neurodegeneration in PD. The use of probiotics and antibiotics and new drug treatments also helps in managing PD very easily. The GUT microbiota is actually a key to a brand new area of neuroscience In sanguine to save millions of lives.

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# 7. Is Vegan Meat Possible?

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#### **ABSTRACT:**

Today meat is not only limited to slaughter of animals, rather several other methods to obtain them have been found with microbes, cell and plants being the common sources that are preferred. There are many advantages of switching to meat substitutes mainly better efficiency, prevention of animal cruelty and maltreatment as well as curbing diseases like diabetes. Also, switching to vegan meat can curb global warming since cattle rearing for meat increases methane in the atmosphere mainly due to the presence of methanogens in their gut. In this study we have discussed how we can obtain meat alternatives that are healthy as well as available to the masses.

#### **KEYWORDS:**

Meat alternatives, microbe-based meat, mycoprotein, plant-based meat, lab grown meat, sustainable meat.

#### Introduction

There are several people in this world who are found to abstain from the consumption of animal meat. Such people are popularly called vegans. The core of veganism lies mostly in ethics but risk of health-based issues can also be a factor. Often meats are rich in cholesterol which can often cause artery blockages, strokes and even cardiac arrest. However, meats are also rich in essential amino acids vital for various functions of the body like protein synthesis and tissue repair. As a result, vegans may suffer from deficiency symptoms like lethargy, hypotonia, muscular dysfunction, seizures etc. Also, global food shortage levels due to overpopulation is also on the hike and demand for meat, being a staple part of the diet of many. Global demand for meat is supposed to hit 455 M metric tons by 2050. As a result, researches have been conducted to produce meat substitutes in such a way that it is appealing to the eye, nutritious yet suitable for vegans, and produced in large quantities. The meat substitutes that we are going to talk about today qualify all the criteria.

#### Plant-Based Meat Alternatives (PBMA)

Among the meat alternatives the most common ones are plant-based meats, which can be further classified into novel and traditional. Fermented foods like tofu, which are popular for quite some time fall under the traditional category. Novel PBMAs use soy proteins added with ingredients like mycoprotein and soy leghaemoglobin. Texturized Vegetable Protein (TVP), also known as Texturized Soy Protein (TSP) is mainly made from the extruded defatted soy meal or soy protein concentrates. It not only has meat-like texture attributes but also similar protein quality comparable to animal proteins.

The production process begins with a protein isolation and functionalization step in which target proteins are extracted from plants and sometimes subjected tohydrolysis to improve their functionalities like solubility and cross-linking capacity. Afterwards, in the formulation step the plant proteins are mixed with food adhesives like plant-based fat and flour to develop a meat like texture. Precision fermentation can also be applied here. It is a

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process which uses a microbe to create a specific enzyme or compound by manipulating its genetic code. This is followed by processing where the mixture of plant proteins and other ingredients is made to undergo protein reshaping processes like stretching, kneading, pressing, folding etc.

Studies have shown that relation between Gut microbiota and PBMA is generally positive. PBMA is rich in butyrate producing bacteria which exercise control on blood sugar level besides destroying harmful bacteria like the members of Firmicutes. Also, butyrate is a preferred energy source for the colon epithelium. It contributes to maintenance of the gut barrier function and has auto inflammatory function.

#### Cell Based Meat (CBM)

Cell based meat also called lab grown meat is basically meat produced by in vitro culture of animal cells by cellengineering. Invented by Mark Post in 2013, it is believed to be safer than many other meat analogues due to absence of allergenic substances found in plant-based meat. A small piece of tissue from living animals is initially excised with a small biopsy under anaesthesia. The obtained cells are cultured within specific liquid media containing some specific nutrients like foetalbovine serum, which provides the conditions needed for tissue growth. Bioreactors are often used for faster cell proliferation.

#### **Microbe Based Meat**

#### From Hydrogenotrophs/Hydrogen Oxidizing Bacteria (HOB)

HOB are bacteria which use CO2 of the air as substrate and hydrogen as the energy source to produce biomass. They are highly beneficial to the planet by cutting down CO2 levels of the atmosphere and controlling global warming. 'Meat' from these microbes are made by putting them inside a suitable liquid and bubbling in hydrogen and carbon dioxide by the process of gas fermentation. However, use of hydrogen makes the process costly. Companies like Solar Foods, Air Protein etc have brought out meat products referred to as solein, popular as protein "made from air".

#### **From Fungi**

1. *Fusariumvenenatum*: It is a fungus naturally found in soil, used to produce Quornmeat by submerged fermentation technology under controlled conditions in bioreactors to create mycoprotein via forming, steaming and, texturizing. The fibrous meat like texture of the final product is due to the filamentous fungi. It is low in fats, high in fibre and has high protein content due to an excellent pattern of amino acids.

2. *Fusariumflavolapis*: A company called Nature's Fynd developed microbial meat product from this extremophile fungus first identified in the geothermal springs of Yellowstone National Park, Chicago. It is inherently 50% protein. Liquid-air interface fermentation is used for harvest. Also, control is exercised on the growth conditions and parameters. No additional materials are required to be used. After the fermentation, the substance is extracted and dried and then used to make the final product.

3. Some companies have also used various species of Mycelium for the process too.

#### Challenges

The path to achieving a society dependent on faux meat is one bereft with challenges since a lot of research and an enormous amount of funding is still required for it. Also, many vegans and animal lovers are still against using it as lab grown meat requires foetalbovine serum for its culture medium which is derived from cow foetuses. Better and cheaper culture mediums need to be formulated to make it cost effective and take animals out of the equation. Also, older generations were observed to be less willing to give up eating meat and switch to such alternatives which act as a big hurdle in consumer market popularity. Unavailability of information, unfamiliarity with the taste of the products; were the key causes for such a response. Also, such meat alternatives are not available to all. Underdeveloped countries cannot adopt them right away. Also, some dieticians have criticised them for their high sodium content.

#### **FUTURE PROSPECTS:**

Minimising resource use and maximising efficiency and product yield is at the core of all alternative meat products. There is scope for wastewater stream integrations from breweries and agro-industries in which lignocellulosic residues would act as environment friendly feedstock for the fermentation process which can also help bring down the price of the products. Although, further research is required to screen for these feedstock resources and optimise fermentation conditions so that fungi do not produce mycotoxins. Meat made from fungal mycelium will make it possible to imitate any muscle structure by aligning the strands in different particular ways. Precision fermentation can help produce enzymes and compounds found in natural meat which will add to the texture, appearance and taste of the final product. Newer research inhigh-pressure homogenization adds to the possibility of using mycoprotein for producing other vegan products in the non-dairy and desserts category. Overall, it would help maintain a almost harmless environmental footprint, have a positive impact on climate change and increase food security while being asustainable food source that is cruelty free for animals.

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# 8. Impact of Biofilm on Medical and Food Industry Juhita Dhar &Zubia Zain

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#### **ABSTRACT:**

A biofilm is a collection of microbial cells that are trapped in a substance's extracellular polymer matrix and adhere to its surface. They differ from planktonic cells because the bacteria in the biofilm provide a more reliable site for reproduction and survival. Biofilm formation is a complicated process involving regulatory mechanisms and multiple biofilm-forming factors. The structure of biofilms is strongly influenced by environmental factors that shape the biofilms to adapt to environmental conditions. cAMP and c-di-GMP are two such important secondary messengers that link environmental components to gene regulation. In addition, quorum sensing also plays a significant role in biofilm formation. Biofilm not only affects the food sector but also the medical sector. In the medical sector biofilms are responsible for device associated infections and chronic diseases. Staphylococcus aureus, Staphylococcus epidermidis are related to 87% of bloodstream diseases. The increasingly grim situation caused by biofilm infection has undoubtedly become the challenge in the area of food safety, as many outbreaks have been found to be associated with biofilm. Public health has always been at risk from foodborne illnesses. Pathogenic microorganisms like yeasts, molds, Escherichia coli, Bacillus spp., Salmonella spp., among others attach to various surfaces and processing equipment in the meat, ready-to-eat foods, poultry and dairy sectors where they produce biofilms and cause infections. These food ailments include Enterohemorrhagic gastroenteritis due to Shiga toxin-producing E. coli, Listeriosis due to L. monocytogenes, and systemic and superficial infections due to Candida spp,. The greatest challenge faced by biofilm is its ability to resist most of the currently existing antibiotics. Due to the protective effect of the biofilm structure, the microorganisms present within the biofilms shows increased resistance to antibacterial treatment compared with those in planktonic state. Biofilm removal is possible by maintaining a systematic cleaning regimen. Today, cold plasma, a non-heat treatment technology, is used in the food and medical industry to successfully remove biofilms from equipment and various surfaces. Traditional biofilm detection approaches, such as agar plating are ineffective as many bacteria like L. monocytogenes may attain a viable but not culturable state with reduced metabolic activity. Thus, in the near future, strong disinfectants and anti-biofilm agents will be desirable to avoid the formation of biofilms in the food sector.

#### **KEYWORDS**:

Biofilms, Mechanisms, Food Industry, Medical Sector, Antibiotic resistance.

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# 9. CELLULAR HOST FACTORS FOR SARS-CoV-2INFECTION

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#### **ABSTRACT:**

By now, we all are very much aware about fact Corona: the pandemic which took away the livesof millions of people globally and lead to severe economic crisis. Coronaviruses are positive-strand RNA viruses belonging to the subfamily Orthocoronavirinae within the family

Coronaviridae (International Committee on Taxonomy of Viruses) It is subdivided into fourgenera—Alphacoronavirus, Betacoronavirus, Gammacoronavirus and Deltacoronavirus.

They are mainly concerned with respiratory ailments and are more vital in animmunocompromised system majorly due to respiratory infection and past exposure. Sevenhuman coronaviruses (HCoVs) have been characterized among which in late 2019, apathogenic coronavirus SARS-CoV-2 was first detected in Wuhan, China, which lead to apandemic outbreak of severe pneumonia globally in very short span. This human pathogen waslikely originated in horseshoe bats and probably transmitted to humans through an intermediatehost that remains to be identified. Due to its high contagiousness and the occurrence of asymptomatic carriers, SARS-CoV-2 has rapidly spread across the globe and is continuing toclaim human lives and obstruct social and economic activity, while vaccination programs are inprogress.

Here in this paper, we would go into detail about the life cycle and the cellular factors thatcause the infection lead by SARS-CoV-2. We will go step by step with the cellular receptors and proteases that are required for SARS-CoV-2 entry. A brief discussion about the molecular genetic level of the cellular host infection including genetic screening has also been discussed.

Finally, we highlight about the antiviral therapies that can prove effective against COVID-19and may give us a solution to this pandemic.

#### **KEYWORDS**:

SARS-CoV-2, Lifecycle, Host Infection, Genetic Screen, Antiviral Drugs.

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# 10.Insight into the survival strategies of Tardigrades, nature's immortal relict

#### Paranjita Raha & Rohan Dan

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#### **ABSTRACT:**

Tardigrades commonly called as water-bears or moss piglets are microscopic animals foundworldwide in aquatic as well as terrestrial ecosystems. They belong to the invertebratesuperclade Ecdysozoa just like Drosophila melanogaster, a very common organism used forstudies.

Tardigrades have long been recognized for being extremophiles as they have the capability tosurvive the foremost extreme environmental conditions.

Recent analysis has shown that tardigrades, even in their active states could also be extremely tolerant to environmental stress, handling extreme levels of ionizing radiation, giant fluctuation in external salinity and avoiding chilling by supercooling to below  $-20^{\circ}$ C, presumably looking forward to an efficient DNA repair mechanisms and osmoregulation.

For its survival in the extremes of condition, Tardigrades evolved a large variety of dormantstages that may be ascribed to

1. Diapause (encystment, cyclomorphosis, resting eggs)

2. Cryptobiosis (anhydrobiosis, cryobiosis, anoxibiosis).

Diapause and cryptobiosis can occur separately or simultaneously in tardigrades, consequently the adoption of one adaptive strategy is not necessarily an alternative to the adoption of the other.

One of the outstanding ways to ensure survival is to enter a state of dormancy with metabolicsuppression known as Cryptobiosis during which they are able to bear almost completedehydration by getting into an inactive state which permits them to tolerate ionic radiation, extreme temperatures and intense pressure where metabolism comes to a reversible standstill. Cryptobiotic tardigrades are able to withstand desiccation (anhydrobiosis) and freezing (cryobiosis) throughout their life-cycle. This ability involves a fancy array of factors working at molecular (bioprotectans), physiological and structural levels.

Tardigrades well known to survive extreme levels of ionizing radiation can survive spacevacuum without loss in survival. Some specimens recovered even after combined exposure tospace vacuum and solar radiation hence proving they can play a vital role in the study of ionizing radiations on the metabolism in metazoans. This makes tardigrades a noteworthycandidate for experimental exposure to open space.

They are also resistant in giant fluctuation in external salinity and avoiding freezing by supercooling to below -20 °C, the most probable mechanism of which is relying onefficient DNA repair mechanisms and osmoregulation which can be studied and utilized.

Tardigrade-specific intrinsically disordered proteins TDPs genes are constitutively expressed thigh levels or induced throughout desiccation in multiple tardigrade species. TDPs arerequired for tardigrade desiccation tolerance, where these genes are sufficient to extended siccation tolerance once expressed in heterologous systems.

# KEYWORD:

Extremophiles, diapauses, Cryptobiosis, space vacuum, Tardigrade-specific intrinsically disordered proteins

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4. Tardigrades as a potential model organism in space research

5. Tardigrades Use Intrinsically Disordered Proteins to Survive Desiccation

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7. Anhydrobiosis in tardigrades—The last decade

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# 11.QUANTUM TUNNELLING; a 'Space Bindingphenomenon linking Relativity and Biochemistry

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#### **ABSTRACT:**

In 1915, Albert Einstein published the General Theory of Relativity where heunified Space and Time in a single unit, famously referred as Space-Time. The theory of General Relativity which made way for Einstein's idea of gravity which contradictedNewtonian concept of Gravity, providing a unified description of gravity as a geometric property of space and time or four-dimensional spacetime. In particular, the curvature of spacetime is directly related to the energy and momentum of whatever matter and radiationare present, this curvature in return defines the movement of celestial bodies or moreappropriately the property called gravity. It revolutionized the understanding of Astro-physicsand refined Newton's law of universal gravitation. But far, far from these revolutionary findings there were certain reactions catalyzed by certain bio catalysts (Enzymes) in the livingworld which had a certain unique character, something which classical reaction kineticsnever allowed. Enzymes are biological molecules that accelerate chemical reactions. They arecentral to the existence of life. Since the discovery of enzymes just over a century ago, we have witnessed an explosion in our understanding of enzyme catalysis, leading to a more detailed appreciation of how they work. A key breakthrough came from understanding howenzymes surmount the potential-energy barrier that separates reactants from products. Basedon current dogma, the vast majority of studies have concentrated on understanding howenzymes facilitate passage of the reaction over a static potential-energy barrier. However, recent studies have revealed that passage through, rather than over, the barrier can occur!

Certain dehydrogenase enzymes catalyzing a redox reaction, involve a transfer of a Hydrogen atom from reactants to products almost instantaneously, which defies the ClassicalBoundaries. This phenomenon can only be idealized if the two distant points on the Reactantsand Products on the Enzyme's Active site become one point, so that the time needed forHydrogen transfer becomes null or zero. A situation much alike the fictional wormholes, defined from the General Theory of Relativity, where instantaneous travel from one point inspace to another point in space, is possible only if the space-time is folded in between.

Hydrogen by its wave-nature tunnels its way through the potential-energy barrier, defyingclassical enzyme kinetics, giving us the name Quantum Tunnelling or HydrogenTunnelling. Does that indicate that Einstein's findings were not only important for theunderstanding of Astro-physics, but would explain quite surreally the reactions taking placein cells since the inception of life?

# **KEYWORDS:**

General Theory of Relativity, Space-Time, Certain dehydrogenase, Hydrogen atom, Enzyme's Active site, fictional wormholes, General Theory of Relativity, wave-nature, Quantum Tunnelling or Hydrogen Tunnelling.



# 12. Smokers and Non-Smokers – Both Facing Alterations in their Microbiota?

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#### **ABSTRACT:**

In the present-day world, tobacco smoking has proceeded to be one of the major concerns due to its adverse effects on the human health which mostly leads to various chronic diseases anddeaths. A research study has shown that because of tobacco smoking, approximately 1.35million people in India and 8 million people worldwide die annually. The primary toxicchemical compounds of tobacco are polycyclic aromatic hydrocarbons (28.8%) and nicotine(59.3%) which being anxiolytic is also addictive in nature. Whenever we talk about the risksof smoking, the first thing that comes to our mind is that it causes cancer, therefore here wewant to focus on a different angle of risk factors in terms of modification of the humanmicrobiome. The active smokers are prone to being susceptible to various bacterial infectionsbut on the other hand the non-smokers, through second-hand and third-hand smoking are alsoat a higher risk.

Smoking has detrimental effects on the oral, lungs as well as the gut microbiome and one of the possible mechanisms of having an altered microbiome is due to immunosuppression. It increases the production of macrophages, eosinophils, mast cells and neutrophils meanwhiledecrease the airway dendritic cells. Further altering the phagocytic function of macrophages, neutrophils, and natural killer cells. Exposure to smoke also enhances the formation of biofilm leading to greater bacterial colonization. Oxygen deprivation promotes the changes in the microbiome by allowing the microaerophilic and anaerobic bacteria to be predominant. It has been seen that in the microbiome of a smoker there is a relative decrease in the number of Prevotella sp. and Neisseria sp. whereas the Firmicutes, primarily Streptococcus sp. AndVeillonella sp. have increased relatively as compared to non-smokers.

Several diseases namely bacterial meningitis, pneumonia, endocarditis, bacteremia, periodontitis, COPD, cystic fibrosis, Crohn's disease, ulcerative colitis etc. and sexually transmitted diseases like gonorrhea and chlamydia have been associated with smoking.

Therefore, smoking being a risk factor effects the human microbiome directly or indirectlyvia different mechanisms as briefly discussed above through immunosuppression, oxygendeprivation, biofilm formation or other possible mechanisms.

The non-smokers are also at a loss because of the involuntary inhalation of the smoke (viasecond-hand smoking) or through exposure to the residues of the tobacco left on the surfaces(via third-hand smoking) which can indirectly alter the chances of bacterial infections.

An experiment was held comparing the indoor home environments of families with one ormore members smoking to the homes of families who are non-smokers. It was seen that therewas a relative abundance of bacterial genera like Staphylococcus, Corynebacterium,Bradyrhizobiumand Veillonella in the homes of smokers than in the homes of non-smokers.

These bacteria could further come in contact with any individual and cause diseases likediphtheria, obstructive pneumonitis etc. There was also presence of nicotine residues onpillow covers, arm rests, bed sheets and floors which via direct contact was found on thehands of a non-smoker individual living in the house of a smoker. Therefore, in houses whereone or more member's smoke, directly harm their own health and also indirectly leads to the gradation in terms of health of other non-smoker members living in the same house.

Despite the graphic warnings of smoking on the cigarette packages and the innumerablecampaigns shown on Tv and newspapers, there has been no reduction in the rate of smokingworldwide which is why other measures can be taken like taxation and creating more supportgroups. The purpose of this topic is to make people even more aware of the fact that besidescancer, there is an array of ways through which inhalation of smoke either directly orindirectly can slowly degrade the body and its microbiome.

#### **KEYWORDS:**

Smoking, Microbiome, Second-hand smoking, Third-hand smoking, Immunosuppression

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# 13. Cryptic dwelling venture of ShigETECformulation-based Combinationvaccine providing broad spectrum based cross- protection from heterologous Shigella strain and ETEC induceddiarrheagenic toxin

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#### **ABSTRACT:**

Developing countries like India are much more susceptible to diarrheal diseases due to lowsanitary infrastructure and lack of general awareness regarding health and hygiene. The mostwidely recognized diarrheal pathogens accounts for Shigella spp (flexneri, sonnei) and ETEC

(Enterotoxigenic Escherichia coli) causing moderate to severe Bloody and Traveler'sDiarrhea respectively. The affected group includes children below 5 years of age as aconsequence of under-developed adaptive immunity and also to travelers from international anddomestic regions moving to certain microbiologically challenged endemic regions. Thus, severalattempts are ongoing to develop broad protection-based prophylaxis against Shigella spp.and

ETEC so as to raise immunoglobulin secreting memory cells which can efficaciously neutralize the antigenic determinants of these two species upon exposure to several times. In this study, arecombinant bivalent construct is made choosing the target epitopes by Lambda Red

Recombinase technique followed by removal of chromosomal genes like rfbF, setBA and infAso as to incorporate attenuation in terms of elimination of immuno-dominant O-Ag of Shigella

LPS and non-invasiveness aiming to provide serotype independent protection against challengeby other heterologous Shigella strains on one hand. On the other hand, deletion of gene infA fromShigella plasmid followed by insertion of infA-LTB-ST N12S was done to stabilize the invasionplasmid in order to ensure expression of antigenic LT toxin for triggering immune response thereby balancing the reactogenicity of heat stable ST. The LTB-ST N12S acts as fusion toxoidimmunogen that is responsible for inducing neutralizing Anti-ETEC Toxin Ab's (serum anti-

LTB and anti-ST IgG) observed and quantitated in GM1 based cell free ELISA lysate furthertested in T84 human colon epithelial cells, The serotype independent protection was assured inmouse lung model of Shigellosis upon intranasal, oral, intraperitoneal immunization followedby challenge with heterologous Shigella strains as observed in the survival curve graph.

Finally, detection of serum-based IgG and mucosal IgA Ab's induced by ShigETEC vaccinationwas done by ELISA. From, the yielded results upon subject to SEC indicated, ShigETECcombination vaccine is a potential

and successful novel live attenuated Combined vaccineproviding broad based cross protection from heterologous Shigella strains and Diarrheagenic ETEC toxins prevailing currently under Phase 1 trials.

# **KEYWORDS:**

Bloody and Travelers Diarrhea, ShigETEC bivalent construct, immuno-dominant O-Ag, infALTB-ST N12S, mouse lung model of Shigellosis, GM1 based cell free ELISA lysate, heterologous Shigella, Diarrheagenic ETEC toxins.

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# 14.Porphyromonas gingivalis: describing the link between periodontopathic infection and systemic diseases

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#### **ABSTRACT:**

Periodontal diseases are mainly the result of chronic infections associated with a number ofbacteria resulting in inflammation and damage to the periodontal structures that support theteeth. In the initial stages of this disease, termed as gingivitis, the gums show swelling, redness, bleeding and this gradually progresses into the later stages known as periodontitis, resulting in tooth mobility and even loss of the tooth. Recently, many evidences provide arelationship between the progress of periodontal disease and the development of systemic diseases like diabetes, rheumatoid arthritis and cardiovascular diseases. Porphyromonasgingivalis, a Gram-negative bacterium, is one such pathogenic bacterium that is responsible for periodontal disease. It is able to produce structures called Outer Membrane Vesicles(OMVs) as a strategy to increase the survival rate of the microorganism and these OMVs arealso able to penetrate deep into host tissues and also migrate to the blood and infect distanttissues and organs, thus, playing a key role in development of systemic diseases, including arthritis and diabetes mellitus. A thorough understanding of the production, virulence factors, mode of action of Porphyromonasgingivalis OMVs can help in designingnew methods for prevention and treatment of this bacterial disease.

#### **KEYWORDS:**

Porphyromonasgingivalis, outer membrane vesicles, gingivitis, periodontitis, systemic diseases

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# **UG SEMESTER 1**



# **UG SEMESTER 5**



# **PG SEMESTER 1**



# . Thawing of Polar Ice Caps and glaciers: A possible gateway and opportunity for the spread of new and diverse pathogens?

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Global warming is causing rapid melting of the permafrost, cryosphere as well as glacier. These frozen environments are reservoirs for many frozen pathogens. Potentially pathogenic bacteria have been isolated from the environmental samples collected from the Arctic. Many dormant but viable microbes are present in the ice cores. These frozen ecosystems are abode to many ancient pathogenic bacteria which can be reactivated as the temperature of the atmosphere is increasing. Amoeboids have been isolated from the frozen sediments, some of which were infected with potentially pathogenic DNA viruses and can be carriers for the same. Nematodes have also been isolated from the frozen soil samples. The cryosphere is also a vast source of Antibiotic Resistant Genes (ARG's).

Due to rapid melting of ice, it has been estimated that approximately  $4x10^{21}$  microbes are released from their frozen confinement and can pose serious threat to human, animal and plant health. This is creating a serious risk for future epidemics to happen more often. There is a possibility of re-emergence of infectious diseases, coming from the depths of thawing glaciers and permafrost, which were thought to be eradicated from the Earth's surface thousands or millions of years ago.

Keywords- Antibiotic resistant genes, epidemic, Global warming, permafrost.

### 2. Presence of Immune Cells Within Human Colorectal Tumors Predict Clinical Outcome

### Arkaprava Ray, SubhadeepPodder

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Histopathological evaluation doesn't say much about post operative outcomes of patients. Here immunoscoring, specifically estimating intratumoural T cell concentration may be of great help. It appears to be the strongest prognostic factor for DFS (Disease Free Survival) and OS (Overall Survival). Genomic and immunostaining analysis are done among cancer patients. Data were entered into a Tumoral Microenvironment Database (TME Database). RT- PCR is done to evaluate expression levels of genes related to inflammation, TH1 adaptive immunity and immunosuppression. Tissue Microarray is also done for understanding in situ adaptive immune response in the center of the tumour and at the invasive margin. Immunostaining was done for total T lymphocytes (CD3), CD8 T cell effectors and their associated cytotoxic molecules and memory T cells. Distribution of immune cell population present inside tumor were compared according to metastatic status of patients. Stages 1-2 are META- Patients (no metastasis), Stage 3 is META + Patients (metastasis in lymph node), Stage 4 is META+ Patients in distant organ. A large part of total genes showed highly significant combinations (P< 0.001) in correlation analysis. In tissue Microarray, tumors from patients without recurrence had higher immune cell concentration than tissue with recurrence. Thus, there was a statistically significant correlation between immune cell density and patient prognosis. For META analysis, in Lo patients, there was no difference between META- and META+ patients. In Hi patients, concentration of tumor associated macrophages and NKT cells was higher in META-Hi patients. Reverse was true for B cells. Above mentioned experiments proved that immune cells, specifically intratumoural T cell concentration helps in preventing metastasis and improves clinical outcome of patients. Concentration of these immune cells regulate patient prognosis.

#### Keywords: Cancer, Immunoscoring, RT-PCR, Immunostaining, Metastases, B and T Cells



# 3. Microbiome is completely absent in some Animal: Unravelling an Enigma

Oishee Janet Sarkar; Anushka Daripa, Jyotipriya Sarkar, Ashmita Chakraborty

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The correlation of gut microbiome and health in humans as well as in other mammals has been well established with various studies. And thus, we developed a notion that without a symbiotic relationship with a microbiota, the organism would simply perish. But the human example is not a good model as a representation of what goes on in other species of animals, such as insects. While some may support a wide range of microbiota in their gut while some simply lack them and that does not support the growth and development of that insect. Thus, the generalization that all organisms must have a healthy symbiotic relationship with microorganisms has been grossly incorrect and the story appears more complex.

### Keywords: gut; microbiota; insects; symbiotic; microorganisms

### 4. Novel, Eco-friendly Bioplastic obtained from Engineered Biofilms

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Plastic pollution is a global menace with only less than 10% of the plastic waste generated being recycled globally. Plastic pollution has far-reaching alterations in the ecosystem's ability to counter climate change and in the lives of millions of people, affecting their way of living in drastic measures. Biodegradable and sustainable bioplastics have been engineered to counter petrochemical based, non-biodegradable plastic but they are limited in number with several constraints imposed upon their production. Here we review AquaPlastic which is durable, water-processable and biodegradable with self-healing properties and is reportedly either comparable or superior to other bioplastics and the usual plastic. Because it is engineered, it is easily scalable and serves to diminish the limitations of production of other bioplastics. Genetically engineered from Escherichia coli biofilms, AquaPlastic stands to be a innovative solutions to packaging and coating applications.

Keywords: plastic, bioplastic, biodegradable

# 5. Melting Permafrost and Future Agriculture

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Permafrost is the frozen subsoil that has remained frozen with its temperature remaining at or below 0°C for at least two consecutive years. It is found in the Northern regions, areas with high altitude and high latitude, mainly in the arctic regions of Siberia, Alaska and Greenland.

Approximately, one quarter of Northern Hemisphere and 17% of the Earth's exposed land surface is underlain by permafrost. Permafrost affects land use by influencing water supply, soil damage, the stability of roads and building and microtopography of the land, which affects the vegetation. Agriculture in the arctic region is of low intensity and inadequate to satisfy the needs of local communities. But it has the potential to increase the local supply of food and even contribute to the global food system.

Global warming has serious consequences which affect agriculture. The climate change in the Northern region is occurring at an unprecedented rate. Globally, permafrost temperature increased by  $0.29 \pm 0.12$  °C, between the years 2007 and 2016. The extended growing seasons allows the expansion of agriculture and the introduction of crops. Converting 10-20% of the of the northern area is potentially suitable for agriculture by the 22nd century. It would be the most productive region for food output. Thus, northern agriculture has the potential to become the net contributor to future global food security. In the thawing permafrost of central Russia, soyabeans were planted on about 2.7 million acres in 2019, which is an 18-fold increase from the past decade and equal to approximately 7% of the total cropland in that part of the country. Russia still relies on imports of about 1 million metric tonnes of soyabean. So domestic harvest in the melting permafrost is expected to grow in the future. According to the Russian government data, Yields have doubled and output almost quadrupled in the past decade due to the improved varieties available in the government.

However, this shift to discontinuous permafrost as the largest provider of agricultural acreage has its own drawbacks. When ice-rich permafrost thaws, the resolving subsidence can cause equipment problems, water logged fields, infrastructure damage and loss of top-soil.

The primary driving force behind the growth of northern agriculture are policies designed to improve local food security and self-sufficiency. This paper focuses on the context and consequences of agricultural expansion into the northern regions, identifying its scope and policies to support a multi-disciplinary research and development for minimizing undesirable outcomes for local populations and ecosystems.

Keywords: permafrost, agriculture, global warming, melting permafrost, increase in agricultural acreage, global food security.

### 6. Phage Therapy – A Potential Alternative to Antibiotic

## Therapy and a Promising Approach to improve Human Health in the Face of Current Antibiotic Resistance Crisis

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Due to the emergence of antibiotic resistant bacterial strains phage therapy is gaining grounds in the therapeutic field recently as an alternative to antibiotic therapy. They play a significant role in the maintenance of human heath through the process of horizontal gene transfer. Although the formulation and commercialization of this therapy provide hurdles, the experiments conducted indicate that it can be used as an effective antibacterial agent against a wide range of bacteria producing biofilms which may be helpful in treating device infections. Other potential advantages include synergy of phage-antibiotic combinations to directly lyse bacterial host cells or apply selective pressure that attenuate virulence and/or resensitize bacteria to specific antibiotic. Lytic phages being able to reduce the bacterial load in short time is more effective in therapy as compared to lysogenic ones. Bacteriophage therapy in combination with systemic antibiotics is also promising in some treatments. To characterize a therapeutic phage, the following parameters must be checked - polyvalent nature, life cycle parameters, morphological analysis, genome analysis, the appearance of bacteriophage insensitive mutants (phage-resistance), and the purity of phages (removal of endotoxin). Encapsulation of phage, a prominent study area was adopted to maintain the viability and stability of phages during treatment. The rising number of phage resistant mutants can be controlled by phage cocktails which restrict frequency of phage resistance. The use of phage therapy in secondary bacterial infections is still under investigation.

#### Keywords: antibiotic resistance, phage therapy, biofilms, phage cocktails



## 7. From Pomegranate Processing By-Products to Innovative value-added Functional Ingredients and Bio-Based Products with Several Applications in Food Sector

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The vast range of by-products and leftovers generated through industrial production processes arises immense environmental, societal and economic related issues. The development of strategies for valorization of the industrial residues would promote bioeconomy and provide sustainable development principles. The production of pomegranate juice generates huge amount of different by-product streams including plant derived non-edible leftovers, comprised mainly of biodegradable compounds and solids. Pomegranate peel and pomegranate seed, the main leftovers of the bioprocess are valuable sources of bioactive phytochemicals, the vast majority of which can be converted into economically valuable products by appropriate processing. Pomegranate byproducts could be used as substrate for the production of nutritionally valuable and biologically active components that could serve as functional food ingredients, food additives, nutraceuticals and supplements and in phenolic-rich diets. Research is ongoing about the potential of converting non-edible pomegranate production process residues to value added products (antioxidants, dietary fibres, industrial enzymes and single cell protein) through novel efficient systems. Scientists have tried to identify pomegranate by-product streams nutritional and nutraceuticals potential, exploit possible processes for the production of medicinal and bioactive compounds through fractionation, as well the production of other value- added products through bioprocesses and investigate possible applications of produced valuables, as food preservatives, quality enhancers and prebiotics in food products. The biorefinery approach leading to sequential production of several valuables can prove to be a promising alternative for the valorization of pomegranate juice solid by-product streams.

# Keywords: Pomegranate; Value Added Products; Bioactive Compounds; Antioxidant; Prebiotics; Single Cell Protein



# 8. Potential Link Between Viruses and Neurological Ailments

### Ahana Nandy, Rajeswari Chakraborty

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Viruses are associated with an array of pathologies and it is really intriguing that a lot of neurological ailments can be influenced by pathogenic viruses. Epstein Barr virus can cause diseases such as CNS lymphoma, encephalitis, meningoencephalitis, autonomic or sensory neuropathy and Parkinson's disease. Multiple sclerosis is known to be associated with several viruses such as Roseolovirus, Varicella Zoster Virus, Epstein Barr Virus. Herpes Simplex Virus type 1 is related to Alzheimer's disease. The presence of viral transcripts and DNA in the cerebrospinal fluid of patients with neurodegenerative disorders such as Alzheimer's disease, Parkinson's disease, multiple sclerosis provide clues towards the possibility of virus infecting the brain cells. Many experiments like temporal and spatial Raman Spectroscopy, Molecular docking and simulations indicated how viral infection alters morphology and biochemistry of glial cells, or how neurodegenerative cascade is initiated by amyloid-like aggregate-forming viral peptides. These viruses might gain direct entry into the CNS and infect the resident cells like astrocytes, neurons, microglia, or the virus infected immune cells may weaken the blood brain barrier and facilitate the entry of peripheral blood cells, which may exaggerate inflammation at the infection site; some viruses might even cause infected immune cells to release some neurotoxic mediators that further leads to inflammatory conditions. Further research on how neurodegeneration is influenced by viruses can lead to the synthesis of various drugs that might be helpful in providing symptomatic relief and further treatments of these diseases.

#### Keywords: CNS, glial cells, inflammation, neurodegeneration, pathogenic viruses

# **9.** Bacterial Bioluminescence

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Bioluminescent bacteria are light-producing bacteria found mainly in seawater, marine sediments, on the surface of decomposing fish, and in the guts of marine animals. These bacteria can be free-living or symbiosis with animals, such as the Hawaiian bobtail octopus (Aliivibriofischeri) or terrestrial nematodes. The host organisms provide these bacteria with a safe home and sufficient nutrition. In return, the hosts use the light produced by the bacteria to camouflage, prey, and/or attract a mate. Bioluminescent bacteria have developed symbiotic relationships with other organisms from which both participants benefit almost equally. Another possible reason bacteria use the luminescence response is quorum sensing, the ability to regulate gene expression in response to bacterial cell density. The biomedical field has greatly benefited from the discovery of bioluminescent proteins. Currently, researchers are using bioluminescence systems for numerous biomedical applications, from highly sensitive cell assays to bioluminescence-based molecular imaging. NanoLuc (NLuc), a novel bioluminescence platform, offers several advantages over established systems, including increased stability, smaller size, and a >150-fold increase in luminescence. In addition, the substrate for NLuc exhibits increased stability and lower background activity, opening new possibilities in the field of bioluminescence imaging. The NLuc system is incredibly versatile and can be used for a wide variety of applications. NLuc has limitations (including non-ideal emission for in vivo applications and its unique substrate) that may cause it to find limited use in some regions of molecular biology. NLuc may have a significant impact in both preclinical and clinical fields with potential roles in disease detection, molecular imaging, and therapeutic monitoring.

# Keywords: NanoLuc Luciferase (NLuc), luciferase, bioluminescence, bioluminescence imaging, bioluminescence resonance energy transfer (BRET)



# 10. Detection of Cannabinoids using GPCR-Based Yeast Biosensor

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Eukaryotic cells use heterotrimeric, G-protein coupled receptors, to sense diverse signals including chemical compounds, light energy, peptides, sugars, lipids, and more. GPCRs are the largest group of membrane receptors and are sometimes also called 'seven-transmembrane' receptors, owing to the seven segments of their single polypeptide spanning the entire width of a membrane. Here, the exploitation of the remarkable sensing capacity of G-protein coupled receptors to construct yeast-based biosensors for real-life applications has been done.

The principal focus so as to ascertain proof-of-concept is cannabinoids ascribed to the presence of their neuromodulatory and immunomodulatory activities. The CB2 receptor which happens to be the peripheral receptor for cannabinoids, is mainly expressed on white blood cells, in tonsils as well as in the spleen. To demonstrate this idea, a CB2 receptor-based biosensor was constructed, and optimized not only to acquire high sensitivity and dynamic range but also to prove its effectiveness in three applications of increasing difficulty. First, the screening of a compound library to find agonists and antagonists was done. Second, a variety of plants were analysed to detect a new phytocannabinoid called dugesialactone, which is, a sesquiterpene lactone that was previously called an anticancer lead. Finally, a robust portable device was developed, which can be applied to analyze body-fluid samples, and confidently detect designer drugs like JWH-018.

These examples demonstrate the potential of yeast-based biosensors to enable diverse applications that can even be implemented by non-specialists. Owning to the extensive sensing range of G-protein coupled receptors, this technology can be extended to detect numerous compounds.

#### Keywords: Cannabinoids, biosensor, GPCR, yeast, detection



## 11. Marine microbial metabolites as a remedy for Alzheimer's Disease

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Alzheimer's can be considered as one of the most common neurodegenerative diseases that leads to dementia among elderly. Formation of senile plaques in extracellular regions of the brain by amyloid- $\beta$  proteins and neurofibrillary tangles in the intracellular region by hyperphosphorylated tau proteins cause widespread damage to nerve cells. Currently drugs, approved by FDA, are used to treat symptoms only, do not stop disease progression and may have debilitating side effects. Secondary metabolites of potential biotechnological interests like Fucoidan, Phlorotannin, Homotaurine, Caniferolide A, Spirolides; isolated from marine microorganisms exhibit anti-inflammatory, neuro-protective properties, which can be potentially exploited for treating AD. Possible mechanisms to counter AD, as demonstrated in various studies already conducted, include prevention of amyloid- $\beta$  protein neurotoxicity by inhibiting multiple enzymes inducing apoptosis and activating genes that stimulate neuronal survival by Fucoidan; inactivating AchE by Phlorotannin along with inhibiting BACE-1 enzyme which is also exhibited by Caniferolide A in addition to reducing neuro-inflammatory markers and ROS. Amyloid- $\beta$  neuro-toxicity can be kept in check by the compound Homotaurine which has high affinity for GABA receptors. Apart from these five compounds, various other marine bacteria, fungi, algae-based metabolites exhibit similar properties and are in the preclinical stage of trial to be marketed as future drugs.

Keywords: Alzheimer's disease, amyloid-β protein, tau protein, GABA, ROS, BACE-1, AchE, Fucoidan, Homotaurine, Caniferolide A, Phlorotannin, Spirolides



## 12.Detection of Quorum Sensing Molecules using biosensors- An early detection system for systemic infections

### Adrija Banerjee and Deepsikha Chatterjee

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The discovery of penicillin marked the inception of the age of antibiotics which has been successful in combating various bacterial diseases. At the same time, repeated use of antibiotics has led to many antibiotics' resistant microbes. A bacterium is said to be resistant to a certain drug when it takes up the DNA fragments through horizontal gene transfer from adjacent surviving bacteria which encode for resistance. Therefore, it is important to develop novel therapeutics in order to mitigate the onslaught of such multi-drug resistant microbes. One such novel method is detection of Quorum sensing molecules using biosensors. QS circuits are used by bacteria to communicate amongst themselves or with other species in order to perform certain functions that help them thrive in difficult conditions. This communication takes place successfully only when the population of bacteria reaches a certain threshold post which aggregates initiate various cellular responses such as resistance, virulence, biofilm formation and resistance. Early detection of such signalling molecules during the onset of infection can help in formulating better treatment procedures. This poster summarizes the plausible mechanisms to detect signal molecules using biosensors such as modified plasmid in E. coli, P. aeruginosa, A. tumefaciens etc. It also focuses on genetically modified antibodies that can help in recognition of such signalling molecules.

# 13.Integration of Microbial Fuel Cells with modified urinal systemsto utilise urinal discharge for improved lighting in rural areas

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Ever increasing energy demand has resulted in unprecedented fossil fuel consumption along withpollution and global warming. There is an urge to find a locum that can meet the sky rocketingenergy demands that does not contribute to pollution and is cheap, sustainable and inexhaustible. A prospective candidate in this endeavor is utilising wastewater. Wastewater has a lot of potential to generate bioenergy which can be employed in various waysto yield fruitful results and in a way substitute the fossil fuels to some extent. Microbial fuel cell (MFC) is one of the ways by which waste water can be efficiently treated bymicrobes to produce useful electrical energy.Microbial Fuel Cells utilising undiluted urine was demonstrated to be an efficient source formicrobes to exploit and generate electricity as it has the organic molecules which the microbescan feed and produce electrons via redox reactions in microbial cells. These electrons can then be harnessed to produce electricity. This novel approach of making cells utilising urine from public urinals can be a boon in decentralised areas where electricity is scarce and costly to implement. Our paper discusses a model of MFC that utilizes cheaper indigenous raw materials to generateelectricity for local use. The raw materials thus used to construct MFCs can also support thelocal industries in our country. Urinals powered by MFCs can provide lighting in rural areas making it safe for women andchildren to travel and use urinals at night. It also reduces the COD to minimal levels and the effluent can be directly released into nearby water bodies without increasing pollution. Also, acatholyte is produced as a by-product that can be used as an effective biofertilizer. Thus, using aurine powered MFC can be seen as a viable solution for providing lighting around the urinals inrural areas.

# 14.Shades of *Clostridium* Species – Binate contributions of the bacteria in various aspects of human life.

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There are different species of Clostridium which have been the concerns of scientific research for many decades. Since the very inception of advancements in the field of biotechnology and harnessing the microbiological knowledge for the welfare and betterment of human civilization, scientists have researched a lot about the numerous species of Clostridium for better understanding of their roles in the microbial ecosystems and dual contributions in human life. Although majority of species of Clostridium have more prominent ill effects on humans than advantageous ones, recent investigational studies and observations have revealed that *Clostridium* novyi-NT spores augment antitumor responses when injected intratumorally and can be used as a potential anticancer agent. It therapeutically eliminates treatment-resistant hypoxic tumors in canine sarcomas by germinating in them and restricting the spontaneity of their occurrences. This can be considered one of the greatest accomplishments by scientists as they revealed the philanthropic side of the bacteria. It is already known that Clostridium botulinum is also an indispensable source of highly lethal and extremely potent botulinum neurotoxin which is one of the deadliest toxins and the primary source of botulism. The convenience of production and transportation of this toxin leads to accentuated misuse and weaponization of bioterrorism. Apart from these, *C.tetani*, *C.perfringens C.sordellii* invasions in human body and its manifestations also find mention in this paper(or poster).

Keywords: *Clostridium*, spores-localization, anticancer response, toxin, botulism, bioterrorism, tetanus, gastroenteritis.

# 15.Green synthesis of silver nanoparticles to compare the anti-microbial activity and toxicity analysis of some commonly found Indian medicinal plants

## Amrita Roy<sup>1</sup>, Debanshi Mitra<sup>2</sup>, Suman Sinha<sup>2</sup>

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The diversity of nature is so phenomenal that we are blessed with tress which are the epitome of hidden treasures. The Indian Flora has got the major importance in all aspects. And one of the main factors is that, the Indian Flora can be used in preparing silver nanoparticles (AgNPs) which has gained much interest in the recent years that is termed as Green Synthesis. This study revolves around that how AgNPs can be prepared effectively and efficiently from 1mM aqueous AgNO3 using leaf extracts of three plants, Musa balbisiana(banana), Ocimumtenuiflorum(black tulsi) and Azadirachta indica (neem), which are adorned for the vast medicinal value. 1mM silver nitrate and 5% leaf extract of each type of plant was reacted for the generation of AgNPs. Then AgNPs were tested for the" zone of inhibition" based on their toxicity and anti-microbial properties. UVvisible spectrophotometer, characterized the different AgNPs generated. Scanning electron microscopy (SEM), Fourier transformed infrared spectrometer (FTIR), transmission electron microscopy (TEM) analysis was carried out further for determining the nature of capping agents in each of these leaf extracts. AgNPs generated showed higher anti-microbial properties against Escherichia coli and Bacillus sp. to that of AgNO3 and raw plant extracts. Even the toxicity evaluation of AgNPs containing solutions were checked on the seeds of Vigna radiata (Moong Dal) and Cicer arietinum (Chickpea) and after treating with AgNP solutions they exhibited better result in terms of germination and oxidative stress enzyme activity. AgNPs turn to be an important element in terms of anti-microbial agent, agricultural stimulation and reliable to use as it is eco-friendly and even can be possibly utilized in the processes of pollution remediation.

Keywords- Silver nanoparticles, Green synthesis, SEM, TEM, Zone of inhibition, Antimicrobial agents, Toxicity

# 16.Polymorphic Microbes: New Emerging Hallmarks of Cancer

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In 2000, Douglas Hanahan and Robert Weinberg published the seminal paper 'The hallmarks of cancer', conceptualizing six core rules which orchestrate the multistep transformation of normal cells into malignant cells. Over 20 years later, in the third update 'Hallmarks of cancer: new dimensions', these six original hallmarks have expanded to 14 with the latest addition of 4 new emerging hallmarks and enabling characteristics, unlocking phenotypic plasticity, non-mutational epigenetic reprogramming, senescent cells, and polymorphic microbes.

Recognition of the microbiome (and 'polymorphic microbes' within them) as a new emerging hallmark of cancer reflects a wide body of rapidly evolving research. Manipulation of the microbiome is showing promise as an opportunity to influence cancer outcomes. The inclusion of polymorphic microbes reflects increasing appreciation that the 'microbiome' has a profound impact on cancer pathogenesis.

Evidence now demonstrates that the microbiome plays a substantial role in tumour genesis, cancer differentiation, and malignant progression. With the emergence of pleomorphic microbes as a new cancer hallmark, there is an opportunity to integrate profiling and targeting of the microbiome into precision cancer care. Profiling of the microbiota in the gut, mucosal surfaces, and the tumour is unlocking new discoveries about the complex relationship between microbes, humans, and cancer.

Polymorphic microbes are potentially instrumental and a quasi-independent variable in how cancers develop, progress, and respond to therapy. Inclusion as a new emerging and enabling cancer hallmark reflects increasing understanding and appreciation of the substantial role that microbes play in cancer. Greater comprehension may permit an opportunity to improve each stage of the cancer care cycle from prevention to treatment for advanced disease.



# 17. Microalgae as a source for pharmaceuticals and nutraceuticals: Biofortification

## Ahana Das, Dhrubaa Roy Chowdhury, Swagata Bhattacharjee

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With the rapid growth in population, the percentage of individuals suffering from various ailments have increased in number. This phenomenon coupled with various lifestyle disorders have led to a surge in demand of various pharmaceuticals and nutraceuticals. Targeted and pinpointed use of various microalgae like *Spirulina plantesis*, *Chlorella sp., Dunaliella terticola, Phordiumautumnale, Aphanizomenonflosaquae*; provides a long-term solution to this. Eventual downstream processing for extraction of various bioactive compounds and utilising them further for biofortification or incorporation into dietary supplements, medicines; is an effective way out of this ordeal. India, with diverse landscape and resources, provides favourable conditions to support microalgae farming: considerable sunshine, general warm climate, sources of Carbon dioxide and other nutrients, easy availability of low-quality water and marginal lands. Domestic and industrial wastewater treatment facilities are considered as potential sites for co-locating algae farms. Wastewater effluents as pond medium provides an efficient and cost-effective way to produce algal biomass. This opportunity conveniently exists in most states of India. Hence, this process, if further exploited, will not only be a sustainable means of production of desired compounds, but also at a reduced cost while being environment friendly as well.

Keywords: Pharmaceuticals, Nutraceuticals, Microalgae, Biofortification, Wastewater treatment, Cost effective, Environment friendly

# 18. Microbial Devulcanization of Ground Tyre Rubber

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Devulcanization of rubber is an essential step for reusing and recycling of used rubber. Unfortunately, the chemical, mechanical or physical method has some severe drawbacks. Some are hazardous towards nature and the environment and some processes cannot simply serve the actual purpose. The ground tire rubber not only contains several important materials but also the energy that is stored inside the rubber as bonds are also important during the recycling process. The stored energy can be recycled too. That's why a recycling process is needed which is environmentally friendly or as less harmful as it can be. This is why devulcanization with the help of microbes came in to thoughts, as previously discussed, the C-C bonds in the rubber polymer is needed to be intact during process but most the processes mentioned above is not very specific. We need the S-S bonds to be broken so while reusing we can form the S-S bond again. Microbes have the capability to degrade specific bonds via enzymatic degradation. The most work has been done with the species Thiobacillus and the strains which shows a great effectivity in GTR recycling are *Thiobacillus ferrooxidans*, *Thiobacillus thiooxidans*. Some organisms like *Sulfolobus acidocaldarius* shows great sulphur utilization from rubber which is used to devulcanize the rubber, especially GTR.

Keywords: devulcanization, desulfurization, GTR, rubber degradation, enzymatic degradation of rubber

# 19. Multi Drug Resistance in Acinetobacter baumannii and Neisseria gonorrhoeae Abhinav Ghosh, Anurag Ghosh, Souravi Adak, PayelAcharjee.

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Vidyasagar College, Calcutta University

Emergence of Multiple Drug Resistance (MDR) in pathogenic bacteria poses great public health threat as there are almost no effective antimicrobial agents available for treating such infections. The resistance develops due to mutations in DNA, or acquisition of antibiotic resistance gene. They can escape commonly used antibiotics and are associated with nosocomial infections. Here, we aim to discuss MDR in Acinetobacter baumannii and Neisseria gonorrhoeae. Acinetobacter baumannii, a Gram negative, coccobacillus is associated with infections in blood, urinary tract and lungs. In regard to mechanism of antibiotic resistance, metallo beta-lactamase and carbapenem hydrolyzing beta-lactamase play the most important role. Secondly, the ability to lose outer membrane protein A allows them to become insensitive to imipenem. Further research shows the presence of RND efflux pump AdeABC, decreased permeability of porins and biofilm formation exhibited by MDR phenotypes. Its genetic plasticity has led to replacements of carbapenem with polymyxins as antibiotic of choice but new strains have already started showing resistance to colistin. Alternative control strategies like – phage and photodynamic therapy, etc are under development. Neisseria gonorrhoeae, a Gram-negative diplococcus causes gonorrhoea. The mechanisms of antimicrobial resistance include production of betalactamase, presence of multidrug efflux pump MtrCDE and mutations in target sites, rRNA and ribosomal protein provides resistance against large number of drugs. Presently a combination therapy of ceftriaxone and azithromycin has been effective. Development of Topoisomerase II inhibitor drugs, use of Lactobacillus strains for the prevention of infection in women and phage therapy have shown considerate progress. The Iraq war and SARSCoV-2 infections opened our eyes revealing the huge number of deaths contributed by A. baumannii. At the same time Gonorrhea continues to emerge as the second most prevalent sexually transmitted infections rendering antibiotics ineffective due to such widespread use. Although new medicines are developed, without behaviour changes MDR will remain major threat.

Keywords: Multi Drug Resistance, Acinetobacter baumannii, Neisseria gonorrhoeae, antibiotic

# **20.PETase-to make the earth plastic free**

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Plastics has been a big threat to the world nowadays. The xenobiotic nature and less degradability of polymeric components has resulted in vast levels of garbage and pollution. Most of the 8.3 billion tons of plastic have been produced since its use became widespread in 1950s still exist in some way. Only 5th of all plastic is recycled. We now have 150 million tons of plastics in our oceans, by 2050 there could be more plastics than fishes. TheAll-India Plastic Manufacturers Association (AIPMA) estimates that the plastic industry produces about 14 million metric tonnes of polystyrene, which is non-biodegradable. According to reports, plastic munching microbes could save the planet from jaws of pollution. Plastic-eating species of bacteria has been uncovered by researchers in Japan, polyethylene terephthalate or PET is the most abundant form of plastic which takes 5to 10 years to degrade. But microbes can degrade this within 6 weeks. *Ideonellasakaiensis*, the bacteria, which can degrade plastics by the enzymes PETase and MHETase, which are naturally occurring enzyme of those species. The chemicals made by this bacterial bioreactor are consumed as food, though one of the byproducts is a compound called terephthalic acid. The bacterial species namely *Exiguobacteriumsibiricumstrain* DR11 and Exiguobacteriumundae strain DR14 were isolated from the wetlands of Shiv Nadar University in Greater Noida. Some well-knowned fungal species like: Aspergillusnidulans, Aspergillus flavus, Aspergillus glaucus, Aspergillus oryzae, Aspergillus nomius, Penicillium griseofulvum, Bjerkanderaadusta, Phanerochaete chrysosporium-are being used nowadays to degrade plastics by using their photodegradation and thermooxidative pathways. So, it can be concluded that to degrade plastics usage of microbes and fungus could be helpful and faster.

#### Keywords- xenobiotic nature, AIPMA, PETase, MHETase, photodegradation, thermo-oxidative pathway

### 21.Genetic Code Expansion and Bio-Orthogonal Labelling Reveal Intact HIV-1 Capsids inside the Nucleus

### Aishi Bhattacharyya, Sayantika Majumdar

Scottish Church College

The HIV-1 capsid, a conical shell encasing viral nucleoprotein complexes, is involved in multiple post-entry processes during viral replication. Microscopy is one of the few techniques that can directly observe the HIV-1 capsid as it traverses the cell. However, the known methods, i.e., intrinsic and extrinsic labelling which are needed to facilitate detection, can perturb capsid behaviour. The cone-shaped mature HIV-1 capsid is the main orchestrator of early viral replication. After cytosolic entry, it transports the viral replication complex along microtubules toward the nucleus. While it was initially believed that the reverse transcribed genome is released from the capsid in the cytosol, recent observations indicate that a high amount of capsid protein (CA) remains associated with subviral complexes during import through the nuclear pore complex (NPC). Observation of post entry events via microscopic detection of HIV-1 CA is challenging. Now, the new technology that has been developed is an indigenous direct labelling technology that uses genetic code expansion and click chemistry to produce infectious viruses whose capsids are labelled with only single modified amino acid. Using this new system, together with electron tomography, it can be demonstrated that the capsid remains intact during its transport into the nucleus of T cells, supporting the late model of uncoating immediately before integration. Combining direct-labelled capsids with fluorescent non-structural viral proteins or host cofactors promises to be hugely enabling for future studies. Moreover, the potential to install a bio-orthogonal label site specifically in the capsid is likely to have exciting applications beyond imaging.

# 22. The Superior Organism- Bt OR Bv? (Comparative Study between *Bacillus thuringiensis* and Baculovirus)

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Bioengineering has exploited two of the most widely-established microorganisms Bacillusthuringiensis and Baculovirus. Bacillusthuringiensis spores express inactive precursor microcrystalline proteins containing cry group of delta-endotoxins which after ingestion specifically binds to intestinal cells of certain insects (lepidopterans) and subsequently this protoxin is cleaved by alkaline proteases displaying toxic activity-damaging surface epithelium by creating pores that cause swelling and lysis. Protection against cotton bollworm encoded by gene cryIAc and cryIIAb and European corn borer by cryIAb. New meta-analysis reveals Bt-crops have no impact on soil biota and impose less impact on non-target organisms when compared to broadspectrum pyrethroid treatment. Baculoviruses forms genome of ds-DNA acting as a gene expression vector. In Baculovirus Expression Vector System, non-essential genes (polyhedrin, p10, basic) of Autographa californica nuclear polyhedrosis virus (AcNPV) is co-transfected into Spodoptera frugiperdafacilitating homologous recombination flanking the chimeric gene-ofinterest. This genus acts as a species-specific narrow-spectrum insecticide, neutralising mostly arthropods without having any negative impact on plants. Recent studies have concluded that Baculovirus shows prominent role in immune-therapy with an enhanced transduction rate. In conclusion it can be proclaimed, Baculoviruses have a wider application compared to Bt bacteria in the world of bioengineering and development.

Keywords: Bioengineering, *Bacillus thuringiensis*, Baculovirus, microcrystalline proteins, insecticide, immune-therapy.

# 23. The Human Microbiome and Bile Acid Metabolism Dysbiosis, Dysmetabolism, Disease and Intervention

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The microbiome plays a variety of role, including metabolic function (absorbing, indigestible carbohydrates) Synthesis function (Vitamin B and k production) and immune role promotion maturation, development of innate and cell mediated immunity, maintenance of intestinal barriers function and appropriate immune response. Bile Acids which are intricately linked to and transported by the gut microbiota, have gained considerable attention in the recent years for their pleiotropic roles beyond lipid metabolism including their ability to differentially activate bile acid receptors. Dysbiosis of the gut is being linked to bile acid dysmetabolism and chronic degeneration disease. The imbalance of Gut microbiota and its metabolites can lead to neurodegenerative disease, cardiovascular disease (Hypertension, heart failure) metabolic disease, gastrointestinal disease. This affect energy absorption, choline, short chain fatty acids (SCFAs), gut brain axis. Recent studies proved that Parkinson, Alzheimer diseases are prone to occur due the imbalance of microbiota. One possibility to restore normal Bile acid metabolism is re-establishment of intestinal bile acid deconjugation by delivering high bile salts hydrolase active probiotics which reduce cholesterol by both luminal deconjugation of the Bile acid and reduction in the sterol absorption. The lumen of gastrointestinal tract is highly anaerobic, microbes must carry out fermentative metabolism. Gut microbiome produce metabolites by fermenting amino acids (cresol, phenylacetate) causing liver disease. From starch, cellulose and plant polysaccharides, they produce SCFAs (acetate, propionate)10% of total calorie intake/day.

### Keywords: Bile acids, Bile acid hydrolase, Dysbiosis, Microbiome, Probiotics.

# 24.Role of *Burkholderia* and impact of K and Mg in soil mineral weathering Boshudhara Banerjee<sup>1</sup>, Rohini Chatterjee<sup>2</sup>, Arpita Das<sup>1</sup>

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Mineral weathering bacteria is known for its important role as biological fertilizers in agriculture by soil formation and element cycling. Bacteria like *Burkholderia*, *Collimonas*, *Pseudomonas* breaks down mineral rocks into sediments, clays, soil, and substances that are dissolvable in water.

The main mechanism usually related to bacterial weathering include pH changes, redox reactions, proton promoted dissolution and chelation of elements that are present in a mineral matrix or the soil.

The mineral weathering ability is determined by an association of certain genes. To allow a comprehensive view, the genes are classified into different categories, i.e., acidification, chelation, mineral-bacteria interaction, and physiological adaptation.

In the current study, *Burkholderia* will be used as a model organism and its role is to be discussed in detail. Interactions showing mineral weathering effectiveness and metabolic activity between silicate minerals and two isolated strains of *Burkholderia*, viz., *B. metallica* F22 and *B. phytofirmans* G34will be shown. These two strains were isolated from rhizosphere soil of *Deyeuxiaarundinacea*.

An experiment on a microcosm study will be highlighted to discuss the taxonomic and functional impact of K and Mg on mineral weathering bacteria. Quantitative PCR showed insignificant taxonomic variations. But, a decrease in the frequency and effectiveness of *Burkholderia* was observed. Availability of K and Mg cations promoted the distribution of the model bacteria.

Keywords: Mineral weathering bacteria, *Burkholderia*, potassium, magnesium, mineral-bacteria interaction

# 25.Importance of Single Cell Protein (SCP) Production in Today's World

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The alarming rate of population growth has increased the demand for food production in third-world countries leading to a yawning gap in demand and supply. By 2050 the world needs to produce 1,250 million tons of meat and dairy per year to meet the global demand for animal derived protein. This situation has created a demand for the formulation of innovative and alternative proteinaceous food sources. Single cell protein (SCP) production is a major step in this direction. Single cell protein refers to the crude and refined or edible protein supplementation of a staple diet by replacing costly conventional sources. More over bioconversion of agricultural and industrial waste to protein rich food and fodder stocks has an additional benefit of making the final product cheaper. This poster will describe the aspects of SCP as an alternative protein-supplementing source, various potential strains and substrates that could be utilised for SCP production and also the future aspects.

# 26.Rapid Detection of Emerging Infectious Agents TamaliNaskar, Narsita Mallick, RiddhikaNaskar

Gurudas College

A major threat to human race, emerging infectious diseases are inevitable and difficult to predict. Constant innovation is necessary to detect and understand the complex and evolving microbial world.Disease testing methods such as rapid immunoassays, mass spectrometry (MS) and broad range of molecular techniques are effective pathogen detection technologies. An important part of microbial diagnostic is nucleic acid amplification tests (NAATs), of which PCR is one example. Reverse transcription (RT) real time PCR and clustered regularly interspaced short palindromic repeats (CRISPR) gene editing are both highly specific and sensitive molecular testing methods targeting bacteria, fungi, viruses and parasites as well as antimicrobial resistance genes. MS is used for protein analysis and rapid screening of microbes. Matrix-assisted laser desorption ionization (MALDI)-time of fight (TOF)-MS accelerates the detection of bacteria and fungi directly from microbial culture. For detecting pathogens which are difficult to culture electron spray ionization (ESI)-MS is used. The use of artificial intelligence (AI) or machine learning (ML) is also applied to infectious disease testing. These combined with less invasive sample techniques (e.g., saliva, breath) via growth direct to consumer (DTC) or over the counter (OTC) testing and also wearable point of care (POC) devices address challenges that limit patient access to healthcare. There will be infections to be diagnosed that we do not know about today and increasing struggle with drug resistant microorganisms. Here we summarized the current trends in infectious disease testing. Leveraging Covid-19 pandemic technologies will be useful in the everlasting fight for survival of human species against pathogens.

# 27. Therapeutic Value of Mushrooms in Oncology

#### Anwesha Sarkar, Snigdhashree Manna, SudiptaHazra

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The estimated number of mushroom species on Earth is 150,000–160,000. However, only 10% of existing mushroom species are known to science so far, while <1% is exploited for therapeutic uses. Cancer is one of the leading causes of death worldwide. Cancer develops through several external factors such as physical carcinogens (ultraviolet radiation), chemical carcinogens (consumption of contaminated water, food, transition metals, asbestos, aflatoxin, tobacco smoke etc.), and biological carcinogens (viruses, bacteria, and parasites). It arises through a transformation of normal cells into tumor cells by a multi-stage process from a pre-cancerous lesion to a malignant tumor. Over 60% of anti-cancer drugs can be traced to natural products, but none so far originated from mushroom. This is surprising, since mushrooms have long been claimed to have anti-cancer effects. "Over the past three decades, scientific and medical research in Japan, China, and Korea and recently in the USA have confirmed the properties and unique compounds extracted of mushrooms for prevention and treatment of cancer and other chronic diseases". They show promising anti-cancer activity and may contain potent anti-cancer compounds. Several mushrooms have been tested in phase I or II clinical trials, mostly for treating breast cancer (18.6%), followed by colorectal (14%) and prostate cancer (11.6%). The majority of clinical studies were carried out with just 3 species- Lentinula edodes (22.2%), Coriolusm versicolor, and Ganoderma lucidum (both 13.9%); followed by two other species: Agaricus bisporus and Grifolafrondosa (both 11.1%). Moreover, most clinical studies have investigated fewer numbers of patients and have been limited to phase III or IV. Henceforth, mushrooms appear to be a neglected natural source, whose therapeutic potential deserves to be explored in a scientific manner for the discovery of new drugs.



# 28.Prevalence of multidrug resistant Staphylococcus aureus in wastewater and human skin

### Anish Kumar Dawn, Ankit Majhi, SupravaAcharya, Dr. Tina Mukherjee, Dr. Senjuti Halder

#### Scottish Church College

The emergence and spread of antimicrobial resistance in pathogenic bacteria are a growing public health issue as these infections cannot be treated through conventional treatment methods. Poor disease control measures, unrestricted and unrequited usage of antimicrobials due to lack of understanding and identification techniques of the pathogen can be cited as the major cause of the spread of multidrug resistance pathogenic bacteria. The present investigation was undertaken to isolate and study the prevalence of multidrug resistant Staphylococcus aureus isolated from wastewater and human skin samples. Staphylococcus aureus has gained its notoriety due to rapid acquirement of drug resistance, thus the treatment of Staphylococcal infections is becoming a challenge to the medical practitioner. The bacterial species is a member of common microflora residing on our skin. Staphylococcus is also a very common species found in wastewater. Thus, in this study both wastewater samples and human skin samples were considered to isolate Staphylococcus aureus. Samples were collected from the following sources- wastewater: sewage water and ganga water and human skin samples from phuchkawala, rickshaw-puller, security guard and garage worker. The isolates were grown on MSA plates and after studying their morphological and gram characters they were identified as Staphylococcus aureus. Antibiotic sensitivity test was performed by Kirby-Bauer method against the following antibiotics-Chloramphenicol, Ciprofloxacin, Amikacin, Streptomycin, Amoxicillin, Cefixime, Tetracycline, Azithromycin, Methicillin, Cloxacillin, Vancomycin, Polymyxin B, Ampicillin. Among these Staphylococcus aurei showed maximum resistance against Cloxacillin and it showed maximum sensitivity to Ciprofloxacin and Tetracycline.

Key words: Antimicrobial resistance, Staphylococcus aureus, multidrug resistance, Kirby-Bauer, Chloramphenicol, Ciprofloxacin, Amikacin, Streptomycin, Amoxicillin, Cefixime, Tetracycline, Azithromycin, Methicillin, Cloxacillin, Vancomycin, Polymyxin B, Ampicillin.

# 29. Ribozyme mediated CRISPR- a Revolutionary Way in Cancer Treatment

### Sreejeeta Kanji, Subham Bhattacharya, Neelotpaal Mondal, Soham Nashipuri

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Ribozymes are the RNA molecules that have the capability to catalyze specific biochemical reactions. They are mainly found in lower eukaryotes where they help in various processes such as rolling replication. However, a potential method has come to light that can be effective for the fight against cancer. CRISPR is a beneficial method for genome editing that has been obtained from specific microorganisms that can be utilized in human genome editing for cleaving specific mutations with the help of the enzyme Cas9. Through various researches it has been observed that genetically modified ribozymes help in increasing the efficiency of the CRISPR tool as required. This method has been observed to work against different types of cancers such as Melanoma, Colon, Breast, etc. CRISPR has been observed to genetically modify the B-lymphocyte cells that would help in particularly identifying cancer cells. The CRISPR tool is guided by the gRNA to a specific target where it performs the required endonuclease activities. It has been observed that ribozyme increases the efficiency of this particular process by specifically producing efficient guide RNAs. This method when performed under specific cell targeting mechanism it provides a chance of the decrease of the rate of cancer to a certain degree. Ribozymes consists of a reduced half-life which can also be genetically modified as well so that the period of its function can be increased. Moreover, this procedure is rapid and economically reasonable than other methods as well. Ribozymes along with CRISPR Cas9 genome editing method can be a remarkable breakthrough in the journey of cancer prevention.

Key words- Ribozymes, CRISPR, Cas9, endonuclease, guideRNA, genetic modification.

# **30.Preventing the Cause of Sterility (PCOS) in women**

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Polycystic ovarian syndrome (PCOS) is a rapidly growing endocrinopathy in women of reproductive age worldwide. With no everlasting solution and scarce research in this field, it affects around 20% women and causes various metabolic disorders, cardiovascular problems and can even lead to cervical cancer. It is known, that gut microbiome is considered a 'virtual endocrine organ' and it is essential for the sustenance of human life. Since PCOS affects gut microbiota significantly by altering the levels of residing microorganisms, restoring their levels to normal can be a significant approach for a solution. Faecal microbial transplantation (FMT) is an important method which has been successfully used to cure the manifestation of C. difficile in humans. In mice models, the same method can be applied to restore the gut microflora that is eventually leading to the regulation of androgen levels, which is the major hormone responsible for various effects of PCOS. The development of insulin resistance is one of the major problems of PCOS whereas clinical trials with FMT has shown positive results for bettering insulin resistance by restoring the human gut flora. Combining these two results, if insulin resistance and androgen levels can be altered with the help of gut microflora, the negative feedback on the GnRH in the hypothalamus can be regulated resulting in the appropriate release of the sex hormones, eventually regulating ovulation and stabilizing the levels of progesterone in blood. This in turn, stabilizes the levels of GnRH with negative feedback from progesterone and the cycle remains balanced. The above results can be a potent approach for a solution to PCOS.

Keywords: PCOS, FMT, androgens, insulin resistance, endocrine.

# 31.Advanced Trends in Regenerative Medicine and Other Bio-applications using Polymeric Scaffolds

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In scientific terms, the word "scaffold" refers to an artificial temporary platform applied to renew or improve the activity of desirable biological structures. Depending on mechanical characteristics, chemical composition and degradation mechanisms, these can be categorized into cell delivery and drug delivery scaffolds. Composed of natural or synthetic, biodegradable or non-biodegradable polymers, it is the central component that is used to deliver cells, drugs, or genes into the body. In regenerative medicine, due to the resemblance of biopolymers with Extracellular Matrix (ECM), these can be used to replace or stimulate regeneration of damaged tissues or organs.

Owing to their anti-microbial, anti-inflammatory and controlled release of therapeutic bio-active compounds into the endosomal compartments of the target cells, they serve as a promising drug delivery agent. Low molecular weight drugs show high drug loading efficiency when loaded into a three-dimensional artificial porous structure and sustain their release for longer duration. Restricted cell proliferation or differentiation make them suitable for tissue remodeling and prevents infection after surgery. Tissue engineering technology uses scaffolds to provide multi-layered network of matrices, transmitting physical and chemical signals, thereby ensuring requisite tissue growth. In contrast to the traditional methods of using donor graft tissues, polymeric scaffolds help to overcome the problems of transmission of diseases and possibility of harmful immune responses. The implanted healing

characteristics of the three-dimensional network structure have the appropriate surface chemistry and topography to positively interact with cells making these biopolymers an active choice for biomedical applications like tissue engineering, drug delivery and regenerative medicine.

#### Keywords: Biopolymer, Scaffold, Regenerative medicine, Tissue engineering, Drug delivery

## **32.Effective Utilization of Microbial Biosynthetic Gene Clusters (BGCs) in Anticancer Drug Formulation**

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The discovery of novel therapeutic anticancer drugs using the high-throughput screening of biosynthetic gene clusters (BGCs) from various microorganisms has been proven to be very effective because BGCs are involved in secondary metabolite production. Various bioinformatical tool-based genome mining approaches can be used to cultivate the entire genome data of the microorganism of interest to identify the cryptic BGCs. The genomisotopic approach and the gene inactivation method are two widely used techniques to produce the products of cryptic gene clusters to improve the screening process. To achieve the full genomics-based approaches, activation of these cryptic BGCs is essential by utilizing various pleotropic methods (e.g., epigenetic perturbation) and pathway-specific methods (e.g., Heterologous expression). Recent biochemical studies of Red Sea Atlantis II (ATII LCL) indicate that its prokaryotic metagenome has putative orphan BGCs that show antitumorigenic effects. Altretamine, Busulfan, and Oxaliplatin are a few anticancer drugs which are produced by targeting the cryptic BGCs of different microbes. According to the current research, BGCs of the anticancer drug bleomycin from *Streptomyces verticillus*can be used as a model for the biosynthesis of hybrid peptide-polyketide. But, genome mining-based approaches can currently only be performed in prokaryotes rather than eukaryotes because prokaryotes are polycistronic in nature, whereas eukaryotes are monocistronic. A decrease in anticancer drug production and a decrease in the novelty of natural products have caused problems in anticancer drug discovery, but we are still successful in developing specialised metabolites from high potential microorganisms to address the health crisis.

Keywords:Biosynthetic gene clusters (BGCs), Genome mining, Genomisotopic approach, Epigenetic perturbation, Heterologous expression.

# **33.Ginger** (*Zingiber officinale*): An Important Medicinal Plant JyotishreeSaha, Sayanti Mondal, Srijita Majumder, Suprativ Das

Sarsuna College

Plants synthesize hundreds of chemicals which have antiviral, antiseptic properties against a variety of pathogens. Using of these chemicals is found to be effective in treatment of diseases and an alternative to chemical formulations.

Ginger(*Zingiberofficinale*) is a potential herb with compounds such as Fe, Mg, Ca, vitamin C, flavonoids which is used worldwide for its immense phytotherapic properties. Chemical called oleoresins extracted from rhizomes of ginger contain bioactive compounds such as 6-gingerol-5-hydroxy-3-decanone which is believed to be responsible for its medicinal properties. Modern researches have shown that ginger have been traditionally used for the treatment of gastrointestinal disorders along with its antinauseatic, antimigraine, antioxidant and anti-hypersensitive properties. There are evidences which show that ginger causes relaxation to chemotherapic effects and the painful period cramps. Some researchers worry that a pregnant woman shall be cautious in the intake of ginger since it might lead to miscarriage if taken in high doses although no proper evidences have been found.
#### 34. Mosquitoes, Infectious Diseases and Cancer – An Unsuspected Connection

#### Avanti Basu, Anisha Dutta, DipanjanaKusary, Sangeet Saha

Gurudas College

Mosquitoes serve as vectors for viruses, protozoa and bacteria and represent a global public health problem. Although, possible connection between mosquitoes and cancer has been studied, limited evidence on this topic is observed. Relevant information had been critically discussed and grouped under four hypotheses. As stated by the first hypothesis, the infection of mosquito-vectored parasites, especially *Plasmodium* spp., might lead to cancer. According to the International Agency for Research on Cancer, being infected by P.falciparummalaria in holoendemic areas is probable to be carcinogenic to humans since the Epstein-Barr virus that leads to Burkitt lymphoma, gets reactivated by *P.falciparum*infection. Burkitt lymphoma is a highly aggressive B-cell non-Hodgkin lymphoma (NHL) where B-cells becomes the primary targets of Epstein-Barr virus infection. P.falciparumenhances the oncogenic effects of EBV on the B-cells. Second hypothesis stated that cancer could be spread directly through mosquito-bites, although there is no such plausible mechanism for the cells developing cancer into the new host. According to the third hypothesis, mosquito bites may lead to hypersensitivity that can result in cancer. Mosquito bites stimulate hypersensitivity which links allergy, oncogenesis and EBV, causing Burkitt lymphoma. An argument based on the aforementioned hypotheses gave rise to the fourth hypothesis which states that pathogens transmitted by mosquitoes may be carcinogenic. The connection of pathogens and cancer needs to be determined urgently as this connection could have strong impacts on the prevention strategies. This will promote multidisciplinary research and discussion to achieve the best health for humans, animals and the environment.

#### **35.Let's Be the Friends of Microbes**

#### AishaniDhali& Rajdeep Boral

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Microbial life is ubiquitous in nature. The ability of these microorganisms to interact and influence and establish relationships with the environment is astonishing. Though there are affirmative effects of microbes in the environment, microbes like bacteria, fungi, viruses, etc all very much hold the power to cause infectious diseases in both flora and fauna. When it comes to human measurement or observation, the effects of microbes on their environment can be advantageous, detrimental, or undetectable. Some positive aspects of microbial effect on the environment is that they play a vital role in recycling various nutrients therefore, participating in biogeochemical cycles. They are also a key component in biodegradation and bioremediation processes. To highlight one of the positive contributions of microorganisms to the environment is production of some valuable metabolic products that can be used to make biodegradable products like BIOPLASTICS. Microbial polymers like Polyhydroxyalkanoates or PHAs are basically considered as bioplastics which are synthesized by a wide variety of microorganisms as carbon and energy source. These biopolymers can replace the harmful and persistent non-biodegradable plastics existing in nature. As excessive use of plastics poses a serious threat to the ecosystem and human life on the planet by accumulating on land and sea has aroused interest to degrade these polymers. In order to overcome plastics associated with environmental problems, understanding of the interaction between microbes and polymers is of prime importance. So, the end product of sugar fermentation by a broad range of hosts of microorganisms such as Alcaligenes eutrophus, Bacillus megaterium, Alcanivoraxborkumensis, etc. give rise to the basic unit of bioplastics along with high yield and quality among other benefits. The biotechnological approach adds to the development of more superior microorganisms that are capable of producing the basic units of bioplastics.



#### 36. Cable Bacteria- Zeus of The Aquatic Microbiota

#### A comprehensive study on the practical applications of an electrogenic bacteria

#### Ankana Nandi, Saheli Basu Roy, Vedant Saha

Department of Biochemistry

Asutosh College (affiliated to Calcutta University)

#### **Introduction:**

Cable bacteria are recently identified members of the *Desulfobulbaceae* family. They are electrically conductive multicellular filamentous bacteria that are found throughout the world and transfer electrons from sulfide oxidation at one end to oxygen reduction at the other end over centimeter distances. Because of their capacity for long-distance electron transport, they are regarded as electric miracles of the microbial world. These bacteria, sometimes known as 'ecosystem engineers' also play numerous roles in biogeochemical cycles.

#### **Practical Applications of Cable Bacteria:**

□ **Bioelectronics:** Experiments have demonstrated that cable bacteria conduct electrons over centimeter distances via highly conductive fibers embedded in the cell envelope. These conductive fibers of biological origin obey a different chemistry as the polyheterocyclic molecules currently used in organic electronics. These finding of a biological structure that efficiently guides electrical currents over long distances greatly expands the paradigm of biological charge transport and could enable new bio-electronic applications.

 $\Box$  Ecological and Environmental Use: An investigation into the distribution of cable bacteria around the roots of aquatic plants, rice, freshwater, and saltmarsh plants, was conducted by a research team led by Dr. Vincent V. Scholz. They used newly generated and public 16S rRNA gene sequence datasets in conjunctionwith fluorescence in situ hybridization. The presence of cable bacteria in plant rhizospheres may have a general impact on the health of the vegetation, primary productivity, methods used for restoring the coast, and the greenhouse gas balance in wetlands and rice fields.

#### **Oil Spills:**

Cable bacteria had a 25% faster rate of hydrocarbon breakdown than any other biobased approach, according to a study done by Dr. Marzocchi. This could form the basis of a creative remedial actions for hydrocarbon spills.

#### **Conclusion**:

The discovery of cable bacteria in the world of microbiology was groundbreaking. Numerous of its qualities have already been recognized, and researchers are constantly making use of theseproperties to create new technologies that can better serve our society. Thus, our poster shall highlight the unique physiological characteristics of the cable bacteria along with the various essential practical applications which have been established through several scientific experimental reports.

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#### **37. Glycolysis (Emp Pathway,1897)** Shrideep Bhadra, Dip Das, Rahul Kanrar

Gurudas College

Glycolysis is a metabolic pathway and an anaerobic source; this process entails the oxidation of glucose. Glucose is trapped by phosphorylation, with the help of hexokinase enzyme. Glycolysis takes place in 10 steps. Five of which are Preparatory phase and five are pay-off phase. Glucose first converts to G6P by hexokinase or glucokinase enzyme. From there the phosphoglucose isomerase isomerizes the G6P to F6P.here comes the PFK-1enzyme which phosphorylates F6P to fructose1.6 bisphosphate. This step is also a rate limiting step and irreversible. In this step fructose 1,6 bisphosphate is lysed into DHAP and GAP .DHAP is turned into G3P by triose phosphate isomerase. In the pay-off phase glyceraldehyde 3-phosphate metabolizes the G3P into 1,3bisphosphoglycerate reducing NAD+ into NADH. Next the 1,3 bisphosphoglycerate loses a phosphate by the way of phosphoglycerate kinase to make 3 phosphoglycerate and creates and ATP through substrate level phosphorylation.2 ATP cerated, the 3-PG turns into 2PG By phosphoglycerate mutase and then enolase turns the 2PG into phosphoenol pyruvate (PEP). In the final step pyruvate kinase turns PEP into pyruvate and phosphorylates ADP into ATP through substrate level phosphorylation, thus creating two more ATP. Overall the input for 1 glucose molecule is 2ATP. So, 2 ATP are used in the initial steps, thus the net gain of ATP is 10-2=8 ATP. (2 NADPH contains 6 ATP molecules). Glycolysis is used by all cells in the body. The final product pyruvate can be used in the TCA cycle or serve as a precursor for other reaction. So, the importance of the biological pathway is principal route for glucose metabolism and allows various tissues, muscles for proper function.





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