جامعة الإمام عبدالرحمن بن فيصل
IMAM ABDULRAHMAN BIN FAISAL UNIVERSITY
معهد الأبحاث والاستشارات الطبية
Institute for Research and Medical Consultations

IRMC - SRP - 2020

(Institute for Research and Medical Consultations - Summer Research Program for Undergraduate Students - 2020)

From 1st June 2020 to 23rd July 2020

SOUVENIR & BOOK OF ABSTRACTS

EDITORS

DR. J. FRANCIS BORGIO, PH.D.

Chairman & Associate Professor of Molecular Genetics, Co-ordinator of SRP,
Institute for Research and Medical Consulations,
Imam Abdulrahman Bin Faisal University.

PROF. EBTESAM ABDULLAH AL SUHAIMI, PH.D.

Dean & Professor of Endocrinology and Physiology,
Institute for Research and Medical Consultations,
Imam Abdulrahman Bin Faisal University.

MS. HIND SALEH ALSUWAT

Editorial assistant,
IRMC, Imam Abdulrahman Bin Faisal University.

JULY 2020.

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| Message from the IAU president |

HE Prof Abdullah Alrubaish

I have been deeply impressed by the marvellous progress of the Institute for Research and Medical Consultations (IRMC) in the field of Advanced Biomedical, biotechnology and Nano Research and Technology. I am extremely happy to know that they have successfully organised Summer Research Program for Undergraduate Students – 2020 (IRMC-SRP-2020) during the pandemic from 01st June 2020 to 23rd July 2020 with sufficient preparations through online and onsite. The theme of the Research Program is very much relevant to achieve the objectives of IAU vision to transfer the knowledge and serve the community, the goals and developmental endeavours of the Kingdom, "Knowledge-based Society and Economy". I strongly believe that the knowledge gained by the Saudi summer research students will go a long way in addressing the challenges on the national and international platform. I extend my good wishes to the Dean of IRMC, The Co-ordinator, Mentors of IRMC-SRP-2020, students and souvenir editorial team and wish for its successful publication. I hope that the discussions during Poster Day of IRMC-SRP-2020 would be brainstorming, ignite the younger minds towards motivated advance research. I wish to compliment them for their novel initiatives and scientifically strong output in achieving higher standards of quality of research.

| Message from the IAU Vice president for Higher Studies and Scientific research |

Prof. Fahad Alharbi

Based on the vision and strategy of IAU scientific research, the Institute for Research and Medical Consultions (IRMC) is carrying out the responsibility of supporting the teaching faculty, postgraduate and undergraduate students by its multiple programs. I am very glad that IRMC has successfully organized the Summer Research Program for Undergraduate Students - 2020 (IRMC-SRP-2020) during the pandemic from 01st June 2020 to 23rd July 2020 with adequate preparations for online and on site in addition to lab skills in order to transfer the scientific knowledge from IRMC-research scientists to young talents from different academic institutions and serve Eastern Province community. This will support the commitment of our university to transfer the Knowledge from lab to Land for fulfilling one branch of the objectives of Saudi Vision 2030. I truly believe that the valuable expertise that is obtained by Saudi summer research students will provide the ability to develop national and international research platform. I express my best wishes to the Dean of IRMC, The Co-ordinator, Mentors of IRMC-SRP-2020, students and souvenir editorial team for their hard work and wish for the successful publications. I look forward to the Poster Day of IRMC-SRP-2020, that will radiate young researcher minds towards advanced research. I admire all of their great ambition and scientifically strong output in fulfilling higher standards of Higher Studies and Scientific research.

| Message from the Dean, IRMC |

Prof. Ebtesam Al-Suhaimi

I would like to thank His Excellency, the President of the Imam Abdul Rahman bin Faisal University, Dr. Abdullah M. Al Rubaish and the Vice President for Postgraduate Studies and Scientific Research, Prof. Fahad Al-Harbi for their continuous support. As an admin and supervisor of summer research program SRP at the Institute for Research and Medical Consultations (IRMC), I envision the institute as part of IAU pivotal strategy for exploitation in new areas of research that may challenge the current academic position. The IRMC is working for future that requires an innovative and unconventional answer that transcends classic disciplines and its boundaries. IRMC scientists and researchers, admin, technical organizations are targeting contemporary problems driving medical biology in the interdisciplinary fields, biotechnology, regenerative and nanomedicine, material science, computational modelling, biophysics, bioenergy and energy. The priority of IRMC is to transfer the knowledge of biotechnology and nanomedicine and their applications to the local community. The unique and impressive IRMC facility is the home of wide range of experiments and experienced researchers. IRMC scientists, professional staff and technicians provide unparalleled scientific and technical support in the region not only to part-time researchers from IAU faculty but also, to train and transfer of technology to the young generations specially on undergraduate students. The annual Summer Research Program is one of the successful programs offered by IRMC, consecutively for the past five

years. Despite the global 2020 pandemic of COVID-19 in this year, IRMC has successfully achieved the outcome of the program by producing thirty abstracts published in WOS indexed Saudi Journal of Medicine & Medical Sciences (SJMMS) in January 2021 issue as happening yearly. In addition, all the 30 internal & external students have been fully trained theoretically and practically for handling the essential skills of the labs and to present their research work effectively. I invite you to visit IRMC website to explore the emerging research output of the program.

I would like to thank the Co-ordinator of IRMC-SRP-2020, Dr. J. Francis Borgio and his team member Ms. Hind Saleh Alsuwat for their continuous efforts for the successful completion of the IRMC-SRP-2020. I congratulate all the Mentors of the IRMC-SRP-2020 for their untiring efforts for the great achievement for completing the research projects and presented their results on time. I would like to thank the Admin Co-ordinator Ms. Noor Ali H. Alrushaid for her hard work. Heartfelt gratitude is extended to all the students for to complete their hard work and following the guidelines. A unique scientific experimental findings and discussions among the Participating Students along with Mentor Scientists of IRMC-SRP-2020 are appropriately summarized in this Souvenir & Book of Abstracts. Heartfelt gratitude is extended to the student participants and organizing team of IRMC-SRP-2020.

IRMC strategic plan forwards to extending its support to all academic and society levels as it is possible

| About IRMC-SRP-2020 |

Institute for Research and Medical Consultations (IRMC) has successfully organized eight weeks undergraduate students research program through online and onsite venues during the pandemic. The undergraduate students from various colleges at Imam Abdulrahman Bin Faisal University (IAU) and other colleges from the Kingdom and an international university were selected carefully based on criteria of IRMC, and scientific background of the student, they were involved in a rigorous and multidisciplinary research training. The program was highly selective and research-based program. Each student was engaged in designated lab under the supervision of a research mentor. Two weeks of seminars and professional development were conducted online through interactive lectures delivered by IRMC scientists. Additionally, IRMC has invited professors from USA and Australia to enrich the program by presenting the trends of international research.

| Objectives of "IRMC-SRP-2020" |

❖ To participate in cutting edge, interdisciplinary research group in the areas of Biomedical, Biotechnology and Nanotechnology.
❖ To expose the students to the real environment of research
❖ To expose the students to the science and technology from international resources
❖ To offer the undergraduate students the opportunity to be junior researchers and authors.
❖ To develop research skills, analytical and writing skills.
❖ To enhance critical thinking
❖ To improve communication skills.
❖ To learning more about academic research career.
❖ To learn how to challenge the difficulties

| Outcome |

❖ IRMC successfully transferred scientific knowledge and technology to fifth batch of talented young Saudi students.
❖ IRMC has effectively participated in a required internship program for undergraduate graduation at IAU.

- ❖ IRMC has productively developed qualified research skilled undergraduate students.
- ❖ All the participants of IRMC-SRP-2020 have submitted their scientific abstract to WOS indexed journals, full research articles are in progress for high impact publications.
- ❖ Today Saudi summer research students are exhibiting and presenting their finding in front of this great audience.

| Brief description "IRMC-SRP-2020" |

The Training and Development Committee at IRMC under the supervision of Prof. Ebtesam Abdullah Al-Suhaimi, designed the program by the co-ordinator of the program, Dr. J Francis Borgio, and the members, Dr. Yassine SLIMANI, Dr. Adeeb Shehzad Muhammad Siar and Ms. Widyan Alamoudi. Later it was finalized and co-ordinated by Dr J Francis Borgio under the supervision of Prof. Ebtesam Abdullah Al-Suhaimi. The event was organized through zoom initially and at building number A70, Institute for Research and Medical Consultations (IRMC), and building number A71, Animal House – IRMC at C1 West Campus, Imam Abdulrahman Bin Faisal University (IAU), Dammam, Kingdom of Saudi Arabia. The program was inaugurated virtually by the Prof. Ebtesam Abdullah Al-Suhaimi, Ph.D. Dean, Institute for Research and Medical Consultations on 1st June 2020 at 10.00 AM. Prof. Ebtesam Abdullah Al-Suhaimi welcomed all the mentors and students and elaborated the importance of the IRMC-SRP-2020. Dr. J. Francis Borgio, Co-ordinator of the Summer Research Program – 2020 was briefed about IRMC summer research program and its schedule. The following mentors from IRMC have accepted and made their valuable presence on the day of inauguration. Their willingness for guiding the students in their respective field of research is being appreciated.

| Field of research and List of mentors |

	Field of research	Specialization	Mentors
1	Biotechnology	Genetics, Epidemic diseases & Stem cell Biology	Dr. J. Francis Borgio Dr. Sayed Abdul Azeez Dr. Huseyin Tombul Oglu Dr. Munther Alomari
2	Nanotechnology and Physics	Nanomedicine & Clinical Pharmacy	Prof. Abdulhadi Baykal Dr. Yassine SLIMANI Dr. Adeeb Shahzad
3	Computational Modeling	Computational Material Science Data Mining	Dr. Ahmed Maarouf Ms. Maha Alshammari
4	Biomedical Engineering	Neuroscience	Dr Murad M. Althobaiti

The First Professional development lecture on Ethical Conduct in Research was delivered by Prof. Ebtesam Abdullah Al-Suhaimi, Ph.D. Dean, Institute for Research and Medical Consultations on 01st June 2020 Monday at 12.30 to 1.30 PM. The following lectures have been delivered by eminent faculties from outside and inside the IRMC. All the lectures were enlightened and very much beneficial for the students.

| List of professional development lectures and seminars conducted |

Venue: Zoom; Duration of the IRMC-SRP-2020 lectures: 1st June 2020 to 14th June 2020

Day	Time	Topic	Faculty
01 June 2020 Monday	10:30-11:30	Professional development Lecture 1 "Ethical Conduct in Research"	Prof. Ebtesam Al-Suhaimi
	12:30-2:30	Professional development Lecture 2 Awareness lecture on laboratory safety	Dr Khaled Salama
02 June 2020 Tuesday	9:00-11.00	Professional development Lecture 3 "Laboratory Animals Ethics, Uses and Animals Models"	Dr Hussein AlHawaj
	12:30-2:30	Invited Specialized Lecture 1 Polymers for Biomedical and Energy Applications	Dr Ayhan Bozkurt
03 June 2020 Wednesday	9:00-11.00	Professional development Lecture 4 Topics on research article writing: Literature Survey and Introduction	Dr Dana Almohazey
	12:30-2:30	Invited Specialized Lecture 2 Superconductivity: Science and Technology	Dr Yassine Abdelhamid Slimani
04 June 2020 Thursday	9:00-11.00	Professional development Lecture 5 Topics on research article writing: Methodology	Dr Rabindran Jermy
	12:30-2:30	Invited Specialized Lecture 3 Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2): An Overview of Structure, Host Response and its current scenario in Children	Dr Suriya Rehman

Date	Time	Title	Speaker
07 June 2020 Sunday	9:00-11.00	Professional development Lecture 6 Basic Biostatistics	Dr Serigne Lo (Adjunct Prof)
	12:30-2:30	Invited Specialized training lab 6 Training on Electron microscopic techniques	Dr Sultan Akhtar
08 June 2020 Monday	9:00-11.00	Professional development Lecture 7 Topics on research article writing: Result, Discussion	Dr Munther Ahmad Alomari
	12:30-2:30	Invited Specialized Lecture 5 Bioinformatics	Dr Sayed AbdulAzeez
09 June 2020 Tuesday	9:00-11.00	Professional development Lecture 8 Structured abstract+ Graphical abstract preparation and Article submission to journals	Dr Adeeb Shehzad Muhammad Siar
	12:30-2:30	Invited Specialized Lecture 4 Consanguinity and complex genetic diseases in Saudi Arabia	Dr J Francis Borgio
10 June 2020 Wednesday	9:00-11.00	Professional development Lecture 9 Introduction to Patent & knowledge based economy	Dr Zagit , USA
	12:30-2:30	Invited Specialized Lecture 7 A Trip to the "Nano" World	Dr Ahmed Maarouf
11 June 2020 Thursday	9:00-11.00	Professional development Lecture 10 "Oral presentation skills "	Dr Hussein Sabit
14 June 2020 Sunday	9:00-11.00	Professional development Lecture 11 Practical session: R	Dr Serigne Lo (Adjunct Prof), Australia

| Project competition |

Student Research Concept Presentation was held on the 4th Week of the program, dated 29th June 2020.

Aim: Three Minutes Project competition to evaluate the students on their competency on understanding the concept of the given research problem.

Panel: The presentations were evaluated by 5-members Panel.

Prof. Ebtesam A. Al-Suhaimi (Biotechnology and Nanotechnology),
Dr. Adeeb Shehzad Muhammad Siar (Biotechnology and Nanotechnology),
Dr. Firdos Alam Khan (Nanotechnology),
Dr. Munerah Abdullah Almessiere (Nanotechnology),
Dr. Yassine Abdelhamid Slimani (Biotechnology and Nanotechnology).

The students were evaluated based on "Research problem clearly stated (30 marks)", "Clear and concise materials and methods (35 marks)" and "Results/ Expected easily and clearly interpreted (35 marks) with cumulative total of 100 marks (30+35+35 =100).

All the students have successfully completed their projects under the supervision of the mentors. Abstract of research projects of the students with the graphical illustration are presented in the following sections.

| Feedback on "IRMC-SRP-2020" |

Fulfil my needs and expectation about scientific research
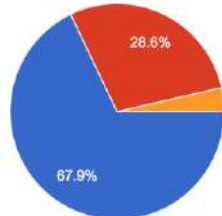
Well organized
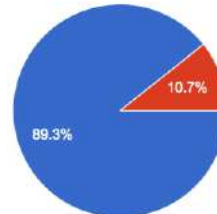
Lectures presented at the right level and right time
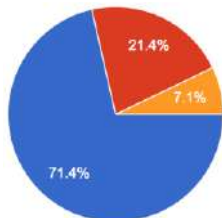
Laboratory hands on training activities
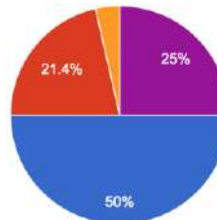
Mentor responded well to questions
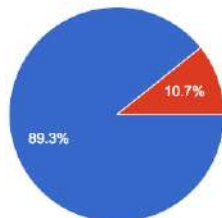
Mentor's handling on the scientific problem
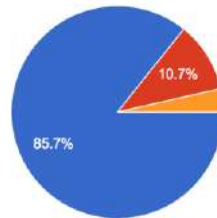
Usefulness of this research program

- ● Excellent
- ● Very good
- ● Good
- ● Fair
- ● Not Applicable
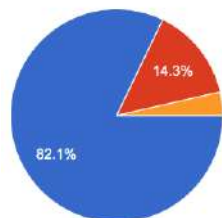
Most of the students appreciated the IRMC-SRP-2020 through their positive response on the feedback survey.

|Self-Evaluation report from students after Online Training|
-As received-

In the past two weeks, I have learned many methods and a lot of information on how to write scientific research, and we discussed many important topics in the field of nanotechnology, superconductor, and infectious diseases. In addition, many rich discussions that took place between students and research professors. In the field of safety, I learned that there is no space for mistakes in the laboratory, and care must always be taken and always ask the supervisor how to protect ourselves from chemical and biological hazards. We also discussed how to deal with the numbers and data provided to us that we obtain during the performance of experiments and how to analyse them as required. I learned how to think critically about research, understanding and using the library and the internet data base for research properly. Also, how to find the right topic, making paper stand out and make my thesis statement. I also learned that flow and organization are two of the most important elements of writing. This means that my research paper must be structured well in such a way that every content element or sections that I write contribute to an overall problem of the research. I will always remember that perfection and procrastination are enemy of good in writing process and be sure to have enough discipline to dedicate time, a regular schedule, for doing the writing process. In the end, I learned how to present my work appropriately, which benefited me and showed me the mistakes that could be made and how to practice it. And reach the highest levels of efficiency in scientific research writing and presentation process.

Ahmed Taha Okasha

After two weeks' training at IRMC, I gained many skills, scientific and practical information. First, I acquired scientific research skills, for example, writing scientific research correctly, also knowing the types of scientific research and the correct way to write and write references and use them correctly. Second, the ability to correct and criticize any scientific article or research. Thirdly, expanding my scientific knowledge in several important fields. I had the opportunity to share my ideas, discuss them, and benefit from the experiences. Finally, I am very happy

to be an IRMC training student and I hope to finish it with a great achievement.

Ahad Saad Alshahrani

The last two weeks were amazing, to know how people do this kind of work as part of their day to day life with this quality and precise is impressing. It made me think of the challenges they face to be in this position. It makes me want to start the research pathway to help the word and make other people live better. I chose the path of technology so I can improve the way we live, technology become an essential part of everyone living in matter of fact it solves our life problems. The thing we study at the IRMC was very helpful I always wonder how I can start my research and I now know but I want to put this knowledge in action. Professional development lecture opens my eyes to a new field. Some of the lectures were kind of difficult to understand since it had new terminology I never heard about and some of them where so interesting like the value-creating lecture. I enjoy the practical lecture like creating a mutation and create a statistical graph. The only thing that I wish is to be at IRMC and take the lectures there and using the lab.

Amaal G. AlOtaibi

During the two weeks we basically learned how to write a research article, it remind me of research methods course, which I studied in my first year of master, so I already familiar with paraphrasing and plagiarism and other stuff but I really enjoyed the lectures and got a lot of idea and learn how to analyse and critique the research article. I am looking forward to the research part and the labs to take more knowledge and experience.

Arwa Ali Almahasheer

The previous two weeks at IRMC-SRP were very informative, wealthy, and absolutely great opportunity. Meeting group of professional professors and doctors, discussing different topics and papers, sharing opinions and knowledge, obviously expanded my experiences, improve my critical thinking and research skills even though they were only online lectures. This program enthused me to read more and join additional courses in scientific approach to improve myself more and more. During

professional development lectures I was gained new knowledge and practiced on new programs such as pymol and RStudio. I never imagined that I would be able to write critical evaluation. I believe that after completing this program, I will highly skilled student.

Areej Hadi Al mebti

I am grateful to be with you in the summer program, it is a great opportunity to join with you. I took two weeks fully with research, lectures that help me to understand what research is and how to be a good researcher in the future. In my opinion, I benefited by ninety percent. I took an online workshop, but the lectures were great for understanding and the doctors explained clearly the lectures.

Bayan Awad Alotaibi

I understand what researchers means by research papers are not all about publication. I learned the importance of writing a well-structured scientific paper from the abstract and all the way to the discussion section, but also the importance of properly cited papers and it influences on the reader or the scientist and whom interested thus direct him to understand accordingly the paper and acknowledging researcher efforts, point of view and the scientific evidence founded. I applied what I learned which guided me to understand as well as how to criticize a journal articles based on basics that I have studied and learned from two weeks ago.

Fatima Dheem Aldosari

In the past two weeks I've learned how to write a scientific article starting from the abstract till the references. At first I was afraid to face some difficulties since I haven't take any research subject yet (it should be taken at year three) but now I can honestly say that I have got the most important lessons that helped me a lot understanding the fundamentals of writing an excellent research and evaluating various types of researches in just two weeks! Before these weeks I had some difficulties in citing the references properly and avoiding plagiarism, but now I can easily handle these. In addition, before I wasn't able to get the correct way to writ the discussion and results but now I've got the right way to write them and evaluate them as well. I have gained a lot more than I

expected and I think I will learn more in the coming few weeks and finally I will be qualified to write a scientific article at the end of this program!
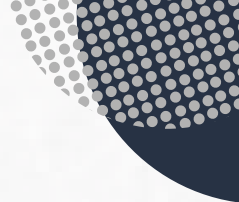
Fatima Fahad Janahi

Our life is a series of choices. And we can do great things with our lives if we carefully choose the best one. Things that matter and things that greatly have an impact on other people's lives. In my curriculum (Energy engineering program), I have taken a directed research course from my electives. It went well and I benefited as a result of that I'm about to publish my first paper. It is now in (Decision on Manuscript) stage. However, here in IRMC summer training, it is well-arranged, even though the current circumstances and the online sessions are perfect. Hopefully at the end of this program I will be able to publish more papers with the help of the mentors and using the laboratories of IRMC and learn from the practical experiments. In my opinion, this program should be essential for all disciplines of science at university. I developed the most with the introduction lecture in a scientific article and how to avoid plagiarism with proper citation. In addition, the abstract lecture was great especially the information was given I did not get it anywhere else. I am really happy to be in this program and had this experience that I will be proud of it always.

Gaeet AlFalah

The change in me? What's changed in me in the past two weeks the ability of solving/writing this assignment itself I never been able to do it two weeks ago the ability to professionally criticism articles and known from a bad article and good. And, where to look for new information. The knowledge that introduces to me of how to write an article and the process and journey of the writing articles the knowledge to know what obstacles that may face me in the future or the field and how to overcome them or even prepare to them. The valuable information that's related to my major (biophysics) that in a way or other it's changed and effected my future.

Hussah Ahmed Aldossary

After attending all the professional development lectures by IRMC I am able to: Distinguish between a poorly written article and a well written article. Distinguish between different types of articles. Know the rankings of scientific journals and articles. Critically evaluate research articles with confidence in my skills and my understanding of appropriate professional literary writing. Understand the fundamentals of writing a scientific article. Easily skim through articles to quickly reach the information I'm looking for after understanding the common sequencing of scientific materials in articles. Understand the common terminologies used to describe articles which will help me review and choose articles for referencing in the future. THANK YOU IRMC.

Latifa Fahd AlOusi

To begin with, I would like to say thank you so much for the opportunity that you gave us to be in IRMS-SRB-2020, I learned so much during these two weeks in many fields, the learning methods was clear and easy to understand. I can confidently say I wouldn't have learned as much as I have these past two weeks without your guidance and effort in educating us. This information you gave us increased my knowledge in many fields that were not my specialty and it was great to know about it with all these details. And I got more knowledge of how to prepare scientific research in detail. Thanks again, and I wish you all the best.

Mai Mansour AlMansour

Before joining the program, I had some ideas on how to do a scientific research, and how to put citations and references. But after joining the program I had learned a lot on how to criticise an article or to review a literature and how to paraphrase and choose the right words. Also, in the last weeks I've learned a lot from the doctors and I carefully listened to their advices on how a researcher begins his/her experiment & how to publish papers, articles etc. I've still got a long way to go, and I'm learning from my mistakes so that I could conquer this. This program will definitely add great value to my skills. Thank you so much for this opportunity.

Maria Almarzoog

The first two weeks of the IRMC summer training program was so beneficial to me I learnt a lot of things in these two weeks these things were taught by a very high quality tutors, for example I did have a good background with regards to abstracts but I learnt even more about abstracts and their different kinds moreover I learnt a lot about the Electron Microscopy (EM) also this is the first time that I criticize a scientific article and I'm still looking forward to learn more from my mentors and I'm very eager to visit the laboratories and learn from the practical experiments.

Moustafa Mwaffak Aouna

IRMC is instituted for Research and Medical Consultations, The program is a guideline that helps us to approach and explore our potential, opens up those possibilities to think beyond what we already know. It also has developed our critical and analytical thinking besides the ability to interpret every cause and case therefore, evaluate the process. Each Doctor especially Dr. Francis Borgio was such a help and supporter toward us and Promotes the understanding that progress has been happening in disciplinary of the scientific fields. What the doctors have discussed and presented it helps me to come up with research ideas and rethink how I can overcome some of the recent problems. Writing an article step by step and cover all ambiguities and frustrations that we could face. As much as , How can the statistical analysis data, writing an article , animal warfare, design presentation followed by using the correct equipment and microscope to mutant and criticize the proposed article?. As a biologist I have been always interest to digging more in research field and this was handful to me. Ultimately, providing some figures below which is some of sessions that I have enjoyed attending it.

Figure1. Creativity you make it with your thinking.
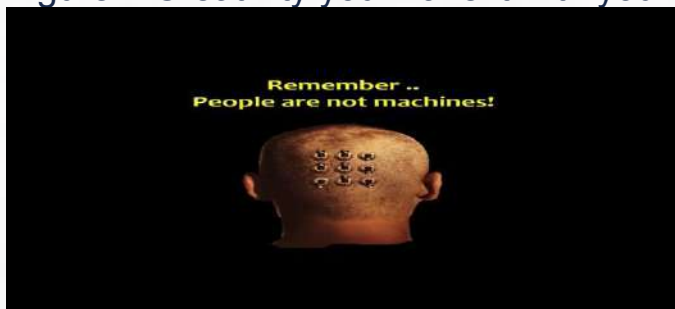
Figure2. The model of writing result part in research field.
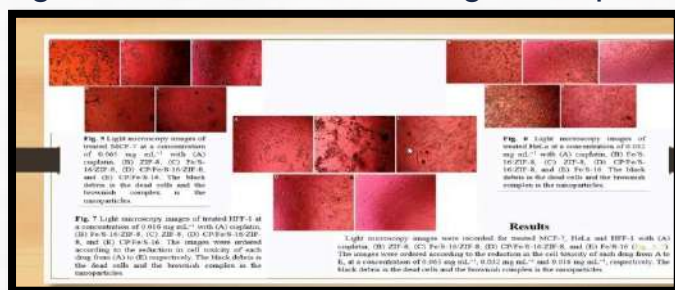
Figure3. Mutant in protein using pymol.
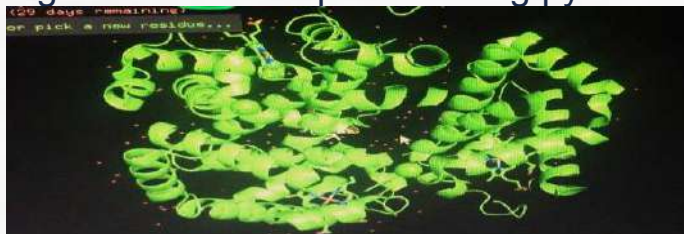
Noha Dhafer Hasan

Self-Reflection: I'd like to believe that I've always had a good exposure to the scientific method and scientific research in my educational background. I took the IB diploma program in high school and we had to conduct our own research for our scientific subjects. Nonetheless, during the last two weeks, I was reminded of the extensive effort that has to be put in conducting research for a higher academic level. While the principal of the scientific method remains the same, it has evolved to encompass a wide variety of topics. I learned that there are vital details to each component of the research and was provided with better checklists to evaluate myself for my next research paper. I think I have become more critical in what I read and exposed to other pioneering Journals such as Nature. I was also provided with more tools to aid in

the presentation of research especially for the graphical abstract and results section. Overall, I believe that the professional development lectures have enriched my knowledge and will very useful for the IRMC Summer research program.

Noor Alsaeed

From the beginning of my acceptance in IRMC-SRP-2020, I was enormously excited for this remarkable journey. I was mainly excited for the experience and knowledge I'm going to receive from this great program. The first two weeks of my attendance, everything was taken online. There was a strict attendance check every 9am and 12:pm, which reflects how serious and professional this program is. The lectures start at a perfect time which is around 9:05am, it's never tiring to wake up for them. The lectures were diverse, from bioinformatic, nanotechnology, and molecular biology to the creation of ideas and research writing. Outstanding professors giving us those informative lectures is such an honor. I appreciate the most Dr. Francis's fast response to any question and for always being there if we face any problem. Furthermore, Ms. Hind's availability in every meeting and for being extremely supportive and cooperative. My experience is immeasurable I'm enjoying every day of this program and trying to learn my best out of it.

Nora Khalid Al-Sudairi

In these two weeks I saw a huge impact on my personal development, and my scientific knowledge, every day I learnt something new and add it to my global knowledge.
To be fair I want to do it as list of everyday gaining skills & information's
1- On 01 of June: I learnt the appropriate way to cite + I discover Mendeley which helped me a lot and made my life easier, we took lecture about research laboratory safety which increase my awareness to this particular aspect.
2- On 02 of June: I didn't know about the real importance of animal ethicality, but after the lecture of Dr. Hussain I knew, Dr. Ayhan give us a lecture of polymers, and from there new page on interest opened to me, I didn't know the rule of polymers in tissue engineering until that day.

3- On 03 June : Dr. Dana taught us how to know if this article going to benefit for your research area by reading the key points of each sentence, and of course it will need more practice to approach the level of advance to get to that point fast and without consuming time, moreover at that day we had a great session with Dr. Yassine, although I'm cell and molecular biology student but I was divert about superconductivity and how certain material will react to certain temperature and how the scientists are aiming to design a superconductor that works at room temperature.

4- On 04 of June: Dr. Rabindran: gave us a lecture was about research methodology, he told us it is easier part in the research paper but we have to be consider of the whole process carrying, Dr. Suriya explain us the virus that is exploring our world recently, she explains the protein associated with it and the impact on children and overall whole ages. 5- On 07 of June, I learned about R program in biostatics as Dr. Serigne show us how we can get a different forms of diagram through the R program, I tried to do a simple trial on this program and it was successful due to his introduction of the R program, after it we took a lecture with Dr. Sultan about EM, we took SEM and TEM and difference between them, I already knew these two types but the gaining part was what the differ between them and what are the situations that we need to use them exactly. 6- On 08 of June with Dr. Munther most important thing I get out after his beneficial lecture that how we should separate between result and discussion, with aware of not repeating what you have already said in result section, furthermore with Dr. Sayed we trained on PyMol and Swiss-PdbViewer, I learnt how to do a mutation for instance, we took Hab1 gene and do a mutation for that specific gene.

7- On 09 of June with Dr. Adeeb I differ between different forms of abstract such, descriptive and informative, we also took a Consanguinity and complex genetic diseases in Saudi Arabia since I said I'm cell and molecular biology student, I understand most of concept but also with Dr. Francis I understand some of things differently such as the different between evolution and mutation I could say that session has a huge impact on me that moment and for the future to explore new way of thinking.

8- On 10 June with Dr.Zagit he introduce me to a strange aspect I could say at that time, I didn't have a full recognition on economic with field of research, but one big lesson I get out of that day is in the end the important thing is the science sharing and benefit your community,
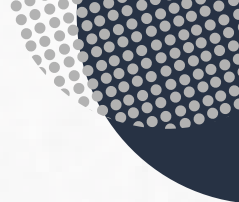
country rather than thinking as it's job to have money of it only. Moreover, Dr. Ahmed introduce the "Nano-subject" which I'm not aware of it that much as it mostly it needed a solid background in physics and chemistry but mostly it was talking about the bond and graphene's, and quasi-1D carbon structure.

9- On 11 of June: That day my personal skills develop with no limitation, today I know the secret of successful oral presentation due to Dr. Hussein.

My Mentally thinking, my scientific knowledge and critical thinking is above the horizon and it's been only two weeks, all my beliefs in this program that will develop and strengthen my personality, and my scientific weakness and allow me to show my strength point too.

Norah Ali AlGhamdi

First, I would love to start by showing my gratitude for the people who work in IRMC, especially the SRP team. The efforts and insights from our supervisors will have a significant impact on us as a fresh researcher. In the past two weeks, I have been learning something new and exciting each day, both in the research field and from scientific perspectives. The research development section was an excellent opportunity to meet the expert scientists, giving us their insight and guidance on how to write professionally and avoid common mistakes in academic writing. Interestingly, Dr. Ebtesam introduced the self-plagiarism issue and explained it very clearly. The acid bath incident that Dr. Francis mentioned reminded me that the researchers must be cautious and patient in their steps. Also, the reproducible concept, fundamental in the research; that I did not come across till now. The research development lectures provide me with a clear understanding of the abstract, introduction, methodology, result, discussion, and conclusion. Other exciting meetings were the invited specialized guests. It was great to see their latest discovery and experiments. It was an interesting and little bit overwhelming journey to be exposed to other fields than my major. It allows me to think of other possibilities in how my knowledge can contribute to other areas. Moreover, the laboratory was enjoyable, since as a programmer, most of my work is with the computer. So to see the different equipment and laboratory procedures gave me more knowledge in that area. Finally, I am excited to start applying what I leaned and contribute to my society—and looking

forward to increasing my knowledge in the next stage of the program. Also, to see how multi disciplinaries can work together to provide excellent results that will enrich the research field.

Norah Abduraheem Alzahrani

Today I have the pleasure To be part of IRMC and write about the experience gained in two weeks. With" IRMC -2020" it allows me to pursue my interests, to learn something new, to hone my problem-solving skills, and to challenge myself in new ways. I learned valuable life skills for life and class such as professionalism, time management, I'm still learning how to use online research tools, and how to effectively communicate your ideas and how to analyze and critique the work of others. One of the things I learned that I feel is important is to be open to the idea that a popular opinion or a preferred result may not be the same as the actual result from the research. If I have a bias for a kind of outcome I should be ready that the research or the actual data may not support it and the outcome may not be expected.

Nouf Essa Aldossary

My experience in IRMC added a lot to my private and professional life. it improved my analytical and search skills as well as communication skills such as listening, speaking and writing. Also, it developed my adaptation skills, by making me learn how to communicate with people from other countries and cultures. IRMC training gave me a lot of opportunities to interact with different disciplines and classmates. Thus providing a greater experience in several fields different from my specialty. and finally, I gained experience in the virtual world which increases my efficiency to achieve my future goals.

Raghdah Atiah Alshumrani

The lectures are very helpful, especially for me as a beginner researcher, I am so grateful because I learned a lot about how to write research papers and scientific articles, my writing skills developed very well, also I learned a lot of new information In different fields in easy, simple way.

Rahaf Braek Alshamrani
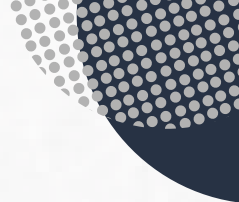
At the beginning of the course it was challenging because it's a new experience for me learning about subjects that I didn't think I would be interested in. Seeing all the Doctors and professors explaining new subject or subject that I knew with enthusiasm urges me to learn more and do my best, but on the other hand it is sometimes difficult and even frustrating to do my best. For example there were assessments where I felt the task was quite challenging for me to complete it successfully. Nevertheless, I am aware that such tasks have made the most significant contribution to my progress and academic process because they encouraged the development of research skills which helped me to learn more about the subjects I learned and to improve my writing and academic performance overall. Thus, I made a considerable progress during the two weeks and I am ready to keep working hard and learn more from such a amazing faculty member

Rahaf Khaled Alquwaie

I will discuss my experience in IRMC2020. It was wonderful and now I got enough knowledge how to prepare a research from introduction, methods, result, and discussion. Also, how to citation and literature survey, as well as the research methodology. And I have information from lectures that were out of my department that gives me good knowledge for example, genes. For the laboratory I learned how to be safety, and I learned the laboratory animal in scientific research how to be safe with animal and when can I use them. Finally, I got the how to present myself. I should be confidence, excited, and have a lot of information that I researched, also to be prepare for the questions that they will ask for. And the last thing is I would thank Dr. Farncis who helps us and make the online lectures more easy and to make everything clear before leave the lesson I will appreciate that.

Rawan Ali Alkhathaami

From Professional Development Lectures: Honestly, I already knew these information, because I'm working as research assistant at IAU research centre, I have 3 research connected with my name on Converis and I had my own experience by doing scientific poster with a title " TAU Protein and Alzheimer's Disease Therapy". It was nice to have revision, I appreciate your effort and I respect all what you are doing for us. From

Invited Specialized Lectures: I had learned a lot from these lectures, it is interesting, keep me thinking, searching and trying to do some applied works. Such as, the mutation we have been doing was attractive lecture for me and I kept using the software's (applications "PDB and PYMOL) even after the lecture and the homework. I also, teach others how to use them. In addition, I liked the lecture of the electron microscope it was enjoyable. In the end chemistry and physics were quite hard a little bit for me since it is not my speciality or directly connected to my field.

Wejdan Mohammed Ali AlGhamdi

| Abstracts from Biotechnology |

IRMC-SRP-2020-01

The impact of Styrene-Acrylic Acid latex nanoparticles on colorectal cancer

Arwa Almahasheer [1,2], Munther Alomari [1*]

[1]Department of Stem Cell Biology, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
[2]College of Science, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.

Abstract

Background: Polymer nanoparticles (NPs) are promising approach for cancer treatment and detection. Due to their biocompatibility, biodegradability, targeting capabilities, capacity for drug loading and long blood circulation time.

Objectives: This study aims to evaluate the impact of polymeric NPs, Styrene-Acrylic Acid latex, on colorectal cancer cells (HCT116).

Methods and Material: Human colorectal cancer (HCT-116) cells were cultured (1.5×10^4) and treated for 24 and 48 hrs with various doses of the NPs (0,25µg/mL,50µg/mL,100µg/mL,200µg/mL,400µg/mL). The cell morphology changes were characterized using optical microscope and the cell number reduction was evaluated by DAPI staining and confocal microscope. In addition, the NPs cell cytotoxicity was evaluated using MTT assay and 96 well plate reader.

Results and discussion: The results showed that the 24hrs treatments with 25µg/mL and 50µg/mL were not effective, while the 100 µg/mL, 200 µg/mL and 400µg/mL treatments showed gradual decrease in cell viability by 8%, 15% and 26%, respectively. At 48hrs treatments, the cell cytotoxicity was 24% at 25µg/mL treatment and significantly increased to reach 52% of cell cytotoxicity at 400µg/mL treatment. In addition, these data were confirmed by optical and confocal microscope pictures.

Conclusions: Styrene-Acrylic Acid latex nanoparticle are highly effective against colorectal cancer cells at high concentration and 48hrs treatment. This indicates that these NPs are safe as drug delivery carrier when used at low concentration.

Key-words: HCT-116, Colorectal cancer, Styrene-Acrylic Acid, NPs, drug delivery.

Key Messages: Styrene-Acrylic Acid nanoparticles are effective and safe as drug delivery carrier when used at low concentration.

*Corresponding Author:
Dr. Munther Alomari,

Department of Stem Cell Biology, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
ORCID ID: https://orcid.org/0000-0001-5705-2926,
Phone: 00966596667991 Email: maomari @iau.edu.sa

Graphical abstract
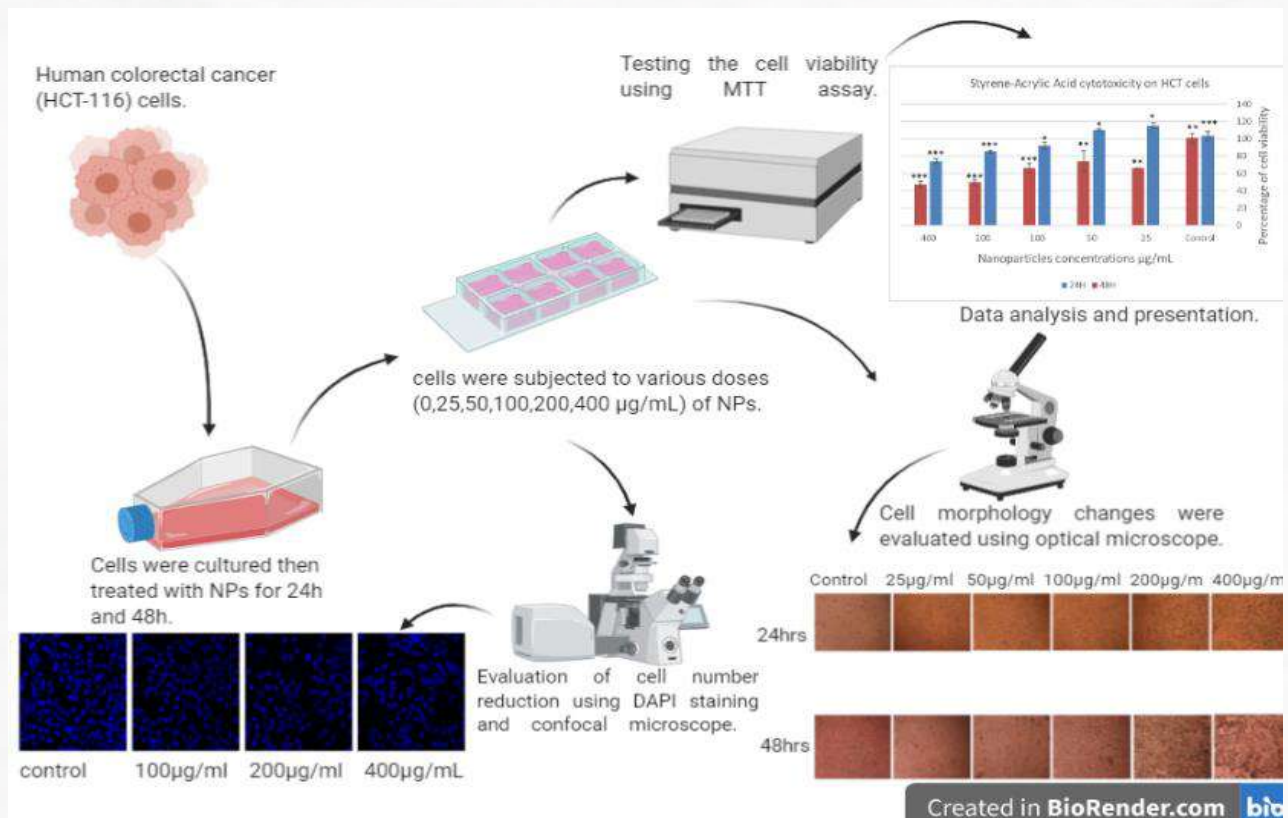
The Effect of Amino Acid Substitutions in *OR9K2* on the Olfactory Neural Response activating Odor Molecules

Wejdan Mohammed AlGhamdi [1,2], Hind Saleh Alsuwat[1], Noor B Almandil[3], Abdulla AlSulaiman[4], Sayed AbdulAzeez[1*], J. Francis Borgio[1] .

[1]Department of Genetic Research, Institute for Research and Medical Consultation (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.

[2]College of Science, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia. [3]Department of Clinical Pharmacy Research, Institute for Research and Medical Consultation (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.

[4]Department of Neurology, College of Medicine, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.

Abstract

Background: Olfactory receptors (ORs) are expressed mainly in the sensory neurons, *OR9K2* is an olfactory receptor, which is located in the nose specifically on the plasma membrane. The main role of *OR9K2* is to initiate neuronal response and odorant signals.

Objectives: The purpose of the study is to identify which amino acid substitution in *OR9K2* make the protein more favourable for odour molecules, which might help in early diagnosis and drug design.

Methods and Material: Using In silico tools, the study focused on selecting the most pathogenic amino acid substitution of *OR9K2* gene, on the data retrieved from NCBI and previously identified prevalent nsSNPs in Saudis using microarray analysis. The study also continues to collect nsSNPs (non-synonymous) of Saudi autistic patients using DNA sequencing. *OR9K2* protein undergo homology (PDB ID: 6tp3.1.A) modelling and validated using RAMPAGE and mutated *OR9K2* generated using SwissPDB and undergo Protein – odour molecule interaction by molecular operating environment. Ten odor molecules were selected that are widely used in Arabian Gulf regions. All the selected odor molecules were docked against the wild and mutated proteins.

Results and discussion: Out of 557 SNPs, twelve most pathogenic nsSNPs were selected based on the cumulative score generated using nine bioinformatics tools and two more nsSNPs were added, which are prevalent in Saudis. Thirty percent (Anisole, Piperonylacetone, delta-Guaiene) of the selected molecules were not interacting with the wild *OR9K2*, however, they are interacting with the mutated *OR9K2*. Sanger sequence analysis revealed a frame shift mutation in the Saudi population.

Conclusions: Interaction of odor molecule with mutant than wild *OR9K2* indicates that the normal protein cannot activate the neural response of olfactory receptors, while the mutated protein (L285R) can highly activate ORs.

Key words: Olfactory receptors (ORs); *OR9K2;* odour molecules; In silico tools; nsSNPs; autism; frame shift mutation; neural response.

Key message: *OR9K2* is a gene that is responsible for smell signals. In our study this gene has some changes in its nucleotides, which cause abnormal neural signals. We investigate that these changes make *OR9K2* more attractive to odor molecule.

*Corresponding Author:

Dr. Sayed AbdulAzeez, Department of Genetic Research, Institute for Research and Medical Consultation (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia. Mobile: 0549950035. ORCID ID: http://orcid.org/0000-0002-9763-9446 Email: asayed@iau.edu.sa

Graphical Abstract:

The Effect of Amino Acid Substitutions in *OR9K2* on the Olfactory Neural Response activating Odor Molecules: Pharmacogenetics Study. Name: Wejdan Mohammed Ali ALGhamdi. Mentors: Dr. Sayed AbdulAzeez, Dr. J. Francis Borgio. Institute For Research and Medical Consultation, Imam Abdulrahman Bin Faisal University.
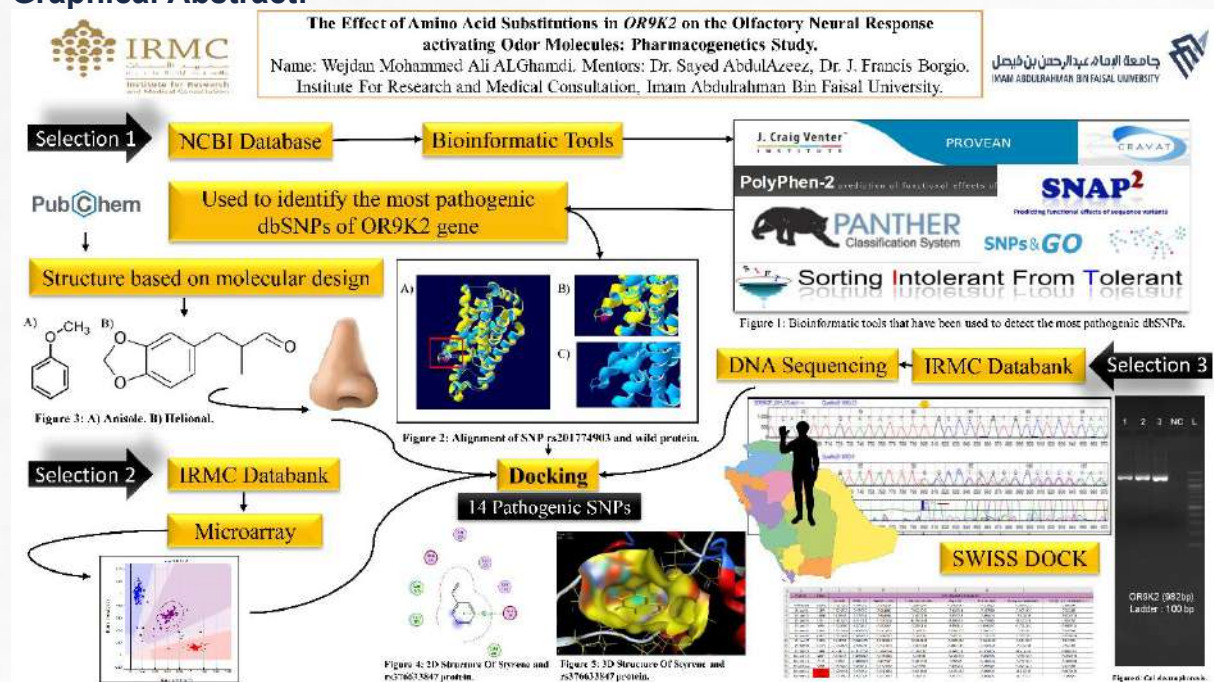
IRMC-SRP-2020-03
Oud Odorant Molecules Interact with Mutated *OR6C74* can Activate Olfactory Receptors

Rahaf Khalid Alquwaie[1,2], Hind Saleh Alsuwat[1], Noor B Almandil[3], Abdulla AlSulaiman[4], Sayed AbdulAzeez[1], J. Francis Borgio[1]

[1]Department of Genetic Research, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
[2]College of Science, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
[3]Department of Clinical Pharmacy Research, Institute for Research and Medical Consultation (IRMC), Imam Abdulrahman Bin Fisal University, Dammam, Saudi Arabia.

Abstract
Background: Previous studies demonstrate that variants at *OR6C74* gene significantly associated with Saudi autistic patients. Interaction of odorant molecules with olfactory receptors (ORs) is the first step in odor identification. There were no studies on possible association of *OR6C74* protein on olfactory impairment.

Objectives: The study aims to identify the influence of amino acid substitutions in OR6C74 on structure, and its interaction with odorant molecules from oud on olfactory receptor activation.

Methods and Material: nsSNPs (non-synonymous SNPs) were identified from NCBI and DNA variants prevalent in Saudi autistic patient through DNA exome microarray and DNA sequencing. Bioinformatics tools were used to detect the most deleterious nsSNPs according to their cumulative score. Homology model was built for the wild OR6C74, validated and mutated to create pathogenic amino acid substitutions. The most ten widely used odor molecule structures were retrieved from PubChem. Molecular docking of wild and mutant proteins with odorant molecules were achieved using Molecular Operating Environment.

Results and discussion: A total of 387 nsSNPs were selected and analysed for the pathogenicity on protein structure. All ten selected odour molecules were docked against the wild and the mutated *OR6C74*. Eight out of ten odour molecules shown highest binding affinity with mutant compared to wild *OR6C74*. The mutated G86D shows the highest binding (S score: -4.7492, -4.6046, -4.1187and -4.6170 kcal/mol) interaction with four odour molecules such as 1-Methoxy-4-methylbenzene, 3,4-Dihydrocoumarin , Benzaldehyde and Guaiacol.
Conclusions: Docking results show that the mutated *OR6C74* has a stronger binding affinity than the wild protein, so it can influence the mutated subjects to activation of olfactory receptors and respond quicker than the normal subject. Among the top ten used odour molecules is toluene, which binds more strongly to the mutated *OR6C74*

than wild. The presence of toluene in habitat can trigger the olfactory receptors in the subjects with mutated *OR6C74* gene.

Key-words: *OR6C74*, odorant molecules, oud, olfactory receptor, homology modelling, molecular docking

Key Messages: A human with a mutated *OR6C74* that interact with oud odour molecules can rapidly activate the olfactory receptors compared to the normal one. Fragrance compatibility matters on the account of genetics.

*Corresponding Author:

Dr. Sayed AbdulAzeez, Department of Genetic Research, Institute for Research and Medical
Consultation (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
Mobile: 0549950035. ORCID ID: http://orcid.org/0000-0002-9763-9446 Email: asayed@iau.edu.sa

Graphical abstract
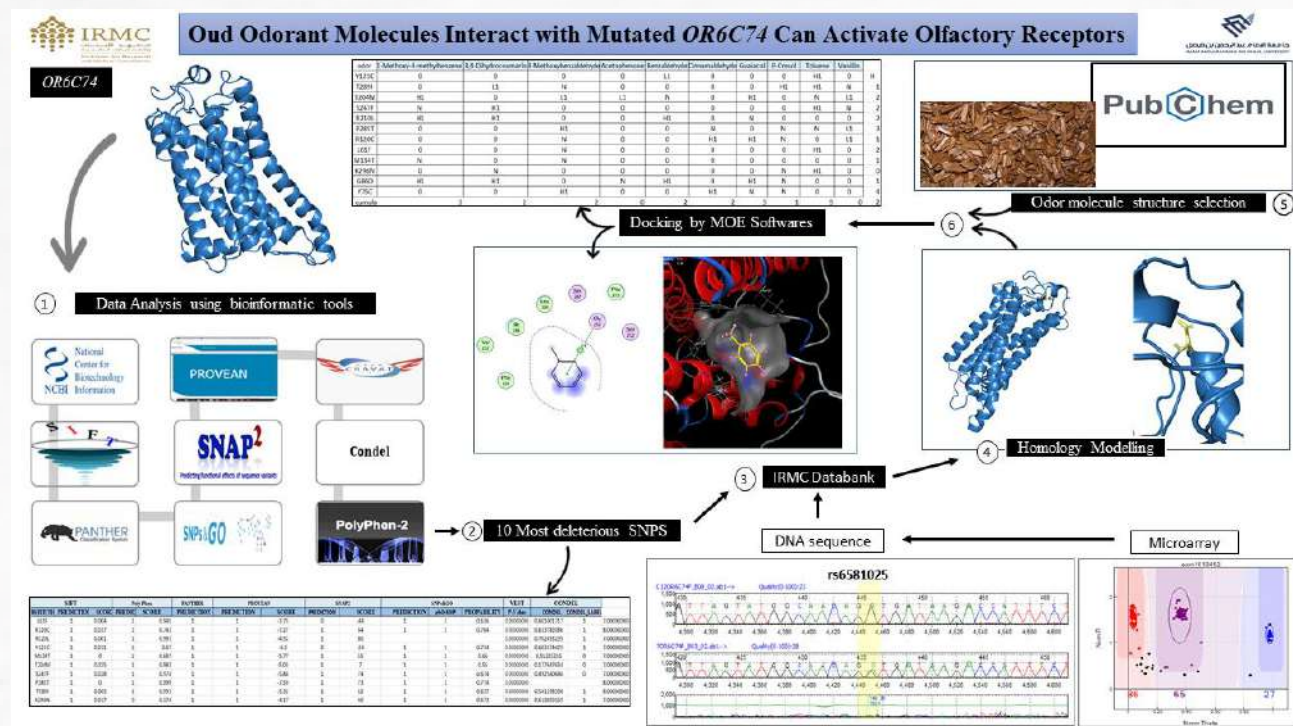
Effect of magnetic iron oxide (Fe₃O₄) nanoparticles on germination, growth, and photosynthesis in barley (*Hordeum vulgare* L.) grown under constant magnetic field

Noha Dhafer ALqahtani[1,2], Huseyin Tombuloglu[1*]

[1]Department of Genetic Research, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
[2]College of Science , Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.

Abstract:

Background: Magnetic iron oxide nanoparticles (NPs) are witnessed progress towards a lot of application in medical, agriculture and nanotechnology. However, This pattern depended on, cell concentration, size, physiochemical properties along with plant species, it can express either a dramatically negative or positive reflect. limited numbers of research articles study the risk of iron oxide nanoparticles exposure and toxicological effect, due to the lack of knowledge on the exact mechanisms of iron oxide uptake and mobilization in plants and multidisciplinary approaches.

Objectives: The objective of this study is to evaluate physiological behavior and growth performance of barley plant under varied magnetic field and NPs conditions.

Methods and Material: 2 samples are the main target of this study i)the seeds were grown in nutrient solution under magnetic field, ii) barley seeds were grown in nutrient solution supplemented with iron oxide NPs under constant magnetic field. examination seed growth by tip root staining with propodeum iodide to analyze the effect of Magnetic and nanoparticles on root tissues under confocal microscopy.

Results and discussion: Confocal microscopy images revealed a synergistic effect injured tissues in both samples in range Highest 550MT and lowest dose 22MT. The results revealed that iron oxide NPs improved the plant growth under magnetic field conditions by enhancing the photosynthetic parameters. However, high doses of magnetic field diminished the growth enhancement. This suggest that magnetic field in low doses can be applied to the plants with NPs treatment.

Conclusions: The successful uptake of SPIONs into the treated plant tissues have also been witnessed. This study examined the effect (Fe3O4) NPs and their impact on physiological, biochemical in barely. Our findings confirmed that strengthening effect of the magnetic field high concentration in combination with iron oxide-NPs increase phonological parameter as growth, yield , photosynthesis efficacy and decrease toxicity in plant.

Key-words: Iron oxide - Nanoparticles-seed germination- magnetic field-barley (*Hordeum vulgare* L.), Magnetic particles.

Key Messages: This study illustrate magnetic iron oxide (Fe_3O_4) nanoparticles influence on germination, growth, photosynthesis rate, and physiological behavior in barley (*Hordeum vulgare* L.) that's grown under constant magnetic field.

*Corresponding Author:
Dr. Huseyin Tombuloglu
Department of Genetics, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
ORCID ID: 0000-0001-8546-2658
Phone: 0530725817   Email: htoglu@iau.edu.sa

Graphical abstract

IRMC-SRP-2020-05
Effect of Fe_3O_4 nanoparticles on germination and expression of stress genes in barley (*Hordeum vulgare* L.) grown under constant magnetic field

Bayan Awad Alotaibi[1,2], Dr. Huseyin Tombuloglu[1*]

[1]Department of Genetic Research, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
[2]College of Public health, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.

Abstract

Background: Nanoparticles (NPs) are commonly defined as particles with sizes between about 1 and 100 nm which exhibit characteristics not found in bulk materials. Fe_3O_4 is a magnetic NP that has an unrecognized effect on plant growth and improvement under continual magnetic field (MF).

Objectives: The aim of this study is to observe the effects of iron oxide Fe_3O_4 (50-100 nm) NPs in barley (*Hordeum vulgare* L.) and how NPs have an impact under magnetic conditions on the plants.

Methods and Material: The Fe_3O_4 NPs were characterized in terms of their sizes and composition by using TEM (transmission electron microscope, FEI, MORGAGNI, 268) and XRD (X-ray diffraction, Rikagu Miniflex) analysis, respectively. 500 mg/L of NPs was applied to barley at seed and growth stages under varied MF conditions (22, 42, 125, and 550 mT). Root and leaf length of the plants were observed continuously for two weeks. Confocal microscope was used to observe the damaged cell at the root tip. Photosynthesis, electron transport rate and chlorophyll florescence of plants were measured by PAM (pulse amplitude modulation).

Results and discussion: The NPs-treated samples under MF 125 mT and 550 mT resulting in high level of germination rate by 80%. Whereas the NPs-untreated samples show low level of germination rate by 60%. The Confocal microscope observation shows that some injured cells and black dots, which are the NPs attached on the cell wall, indicate that NPs-treated samples have more positive effect in growth enhancement than untreated samples when exposed to the continuous MF. Moreover, the photosynthesis analysis shows that the photosynthesis ratio decreased in the NPs treated samples, showing the efficiency of photosystem II decreases and the photosystem I open. The light-adapted electron transport rate parameter also increased in the NPs-treated samples.

Conclusions: Iron oxide (Fe₃O₄) nanoparticles showed a strong effect in stimulating plant growth even under a high magnetic field. Plant seeds under the influence of the MF had a higher germination rate, and these plants grew taller, bigger, and healthier than those in the control group.

Keywords: Fe₃O₄ nanoparticle, barley (*Hordeum vulgare* L.), plant development, photosynthesis, magnetic field.

Key Messages: Even under a strong magnetic field, iron oxide (Fe3O4) nanoparticles demonstrated a powerful effect in stimulating plant growth.
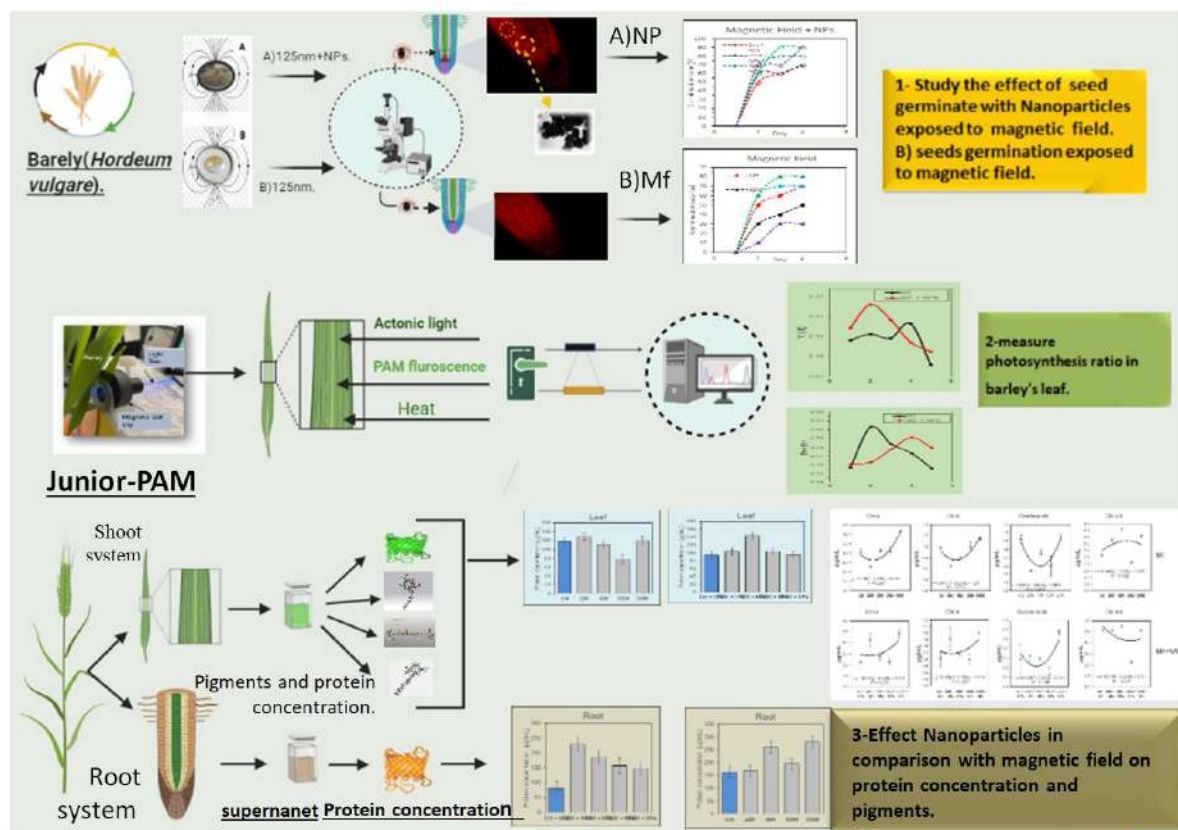
*Corresponding Author:
Huseyin Tombuloglu,
Department of Genetics Research, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
ORCID ID: https://orcid.org/0000-0001-8546-2658
Phone: +966530725817 Email: htoglu@iau.edu.sa

Graphical abstract

Effect of Fe₃O₄ nanoparticles on germination and expression of stress genes in barley (*Hordeum vulgare* L.) grown under constant magnetic field.
Bayan Awad Alotaibi, Dr. Huseyin Tombuloglu
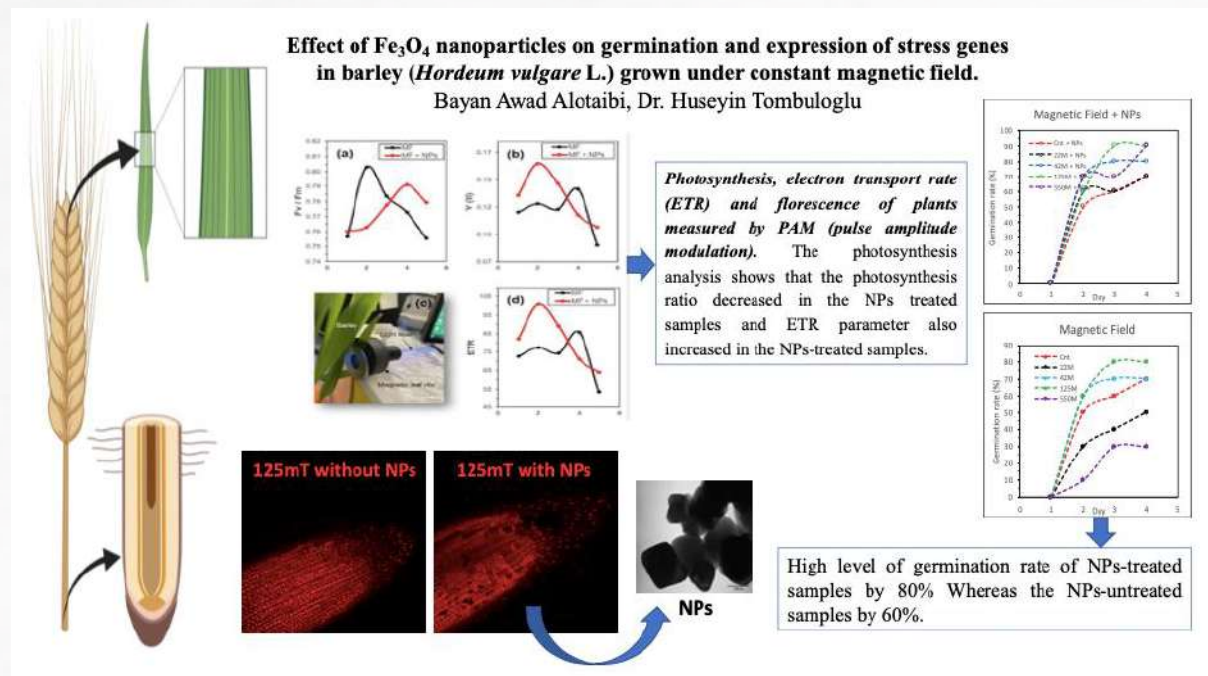
IRMC-SRP-2020-06
The Efficacy of Dexamethasone on the Treatment COVID-19 Patients

Noor Alsaeed [1,2], Adeeb Shehzad [1*]

[1]Department of Clinical Pharmacy, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
[2]College of Medicine, Royal College of Surgeons in Ireland, Dublin, Ireland.

Abstract

Background: The global pandemic of COVID-19 is a viral respiratory illness caused by the novel coronavirus, SARS-COV-2. Currently, no treatments or vaccines are available to prevent this disease, consequently causing a burden on healthcare sectors worldwide. There is compelling evidence that the use of synthetic corticosteroid Dexamethasone can be helpful and beneficial in the treatment of COVID-19 patients.

Objectives: To determine the mechanism of action, characteristics, efficacy and limitations of Dexamethasone as an antiviral agent for the clinical outcomes of COVID-19 patients in critical condition.

Methods and Material: An online search was conducted using scientific databases for studies associated with the use of corticosteroids and the use of Dexamethasone on viral respiratory illnesses including SARS, MERS and COVID-19 from 1st January 2020 to 23 July 2020.

Results and discussion: Co-administration of systemic Dexamethasone with other antiviral agents may improve clinical outcomes in COVID-19 patients, suffering from severe respiratory symptoms. It can reduce viral clearance and prevent a cytokine storm. However, it can delay viral clearance due to its immunosuppressive effects and may not always improve the prognosis of disease.

Conclusions: Dexamethasone suppresses inflammation by mimicking anti-inflammatory hormones and can be useful for oxygen and ventilator dependent COVID-19 patients. Further studies and large-scale clinical trials are needed to determine full efficacy.

Key-words: *Dexamethasone, Corticosteroids, COVID-19, SARS-CoV-2, SARS, MERS.*

Key Messages: Dexamethasone can be incorporated, with limitations, in the treatment of COVID-19 patients with severe respiratory to improve clinical outcomes.

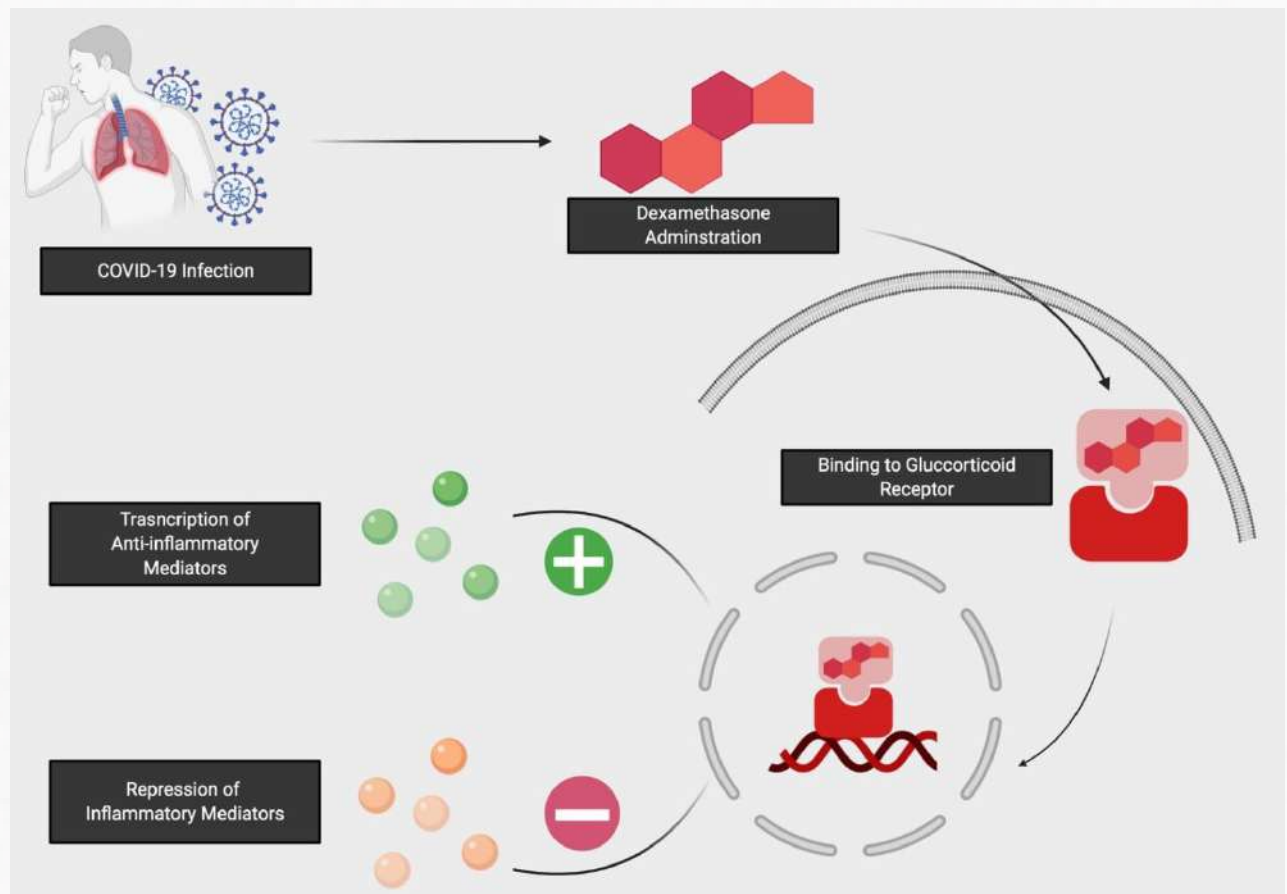***Corresponding Author:**
Dr. Adeeb shehzad,
Department of Clinical Pharmacy, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
ORCID ID: https://orcid.org/0000-0003-1335-0571
Phone: +966 590252826
Email: asmsiar@iau.edu.sa

Graphical Abstract

IRMC-SRP-2020-07
Tamoxifen-titanium silicate nanoparticles inhibit the cell proliferation of Tamoxifen resistant cervical cancer cells

Maria Nory Almarzoog [1,2], Munther Alomari [1*]

[1]Department of Stem Cell Biology, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
[2]College of science, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.

Abstract

Background: Tamoxifen (TAM) attaches to estrogen receptors (ERs) at the cells surface of breast cancer cells, resulting in inhibition of cell proliferation. Low or negative ERs expression at cancer cells surface such as, cervical cancer cells (HELA), will result in TAM resistant.

Objectives: This study aims to enhance the delivery of tamoxifen (TAM) into a negative or low Estrogen receptor (ER) expression cancer cells, by conjugating TAM to titanium silicate nanoparticles.

Methods and Material: Cervical cancer cells (HELA (ER-negative)) were cultured in 96 well plate and treated with varied doses (20, 80, 160, 320 µg/ml) of TAM + titanium silicate, TAM alone or titanium silicate alone. The optical microscope was used to check the cell morphology and number reduction. The cytotoxicity of the nanoparticle and TAM was evaluated by cell viability assay (MTT) and 96 well plat reader. Of the resulted data the LC50 was calculated and statistical analysis were performed using T-test.

Results and discussion: HELA cells treated with Tamoxifen alone (LC50: 318.5923 µg/ml) or titanium silicate alone (LC50: 701.26 µg/ml) showed a very low response and no change at cell morphology or number at the used doses. On the other hand, treatment with TAM + titanium silicate conjugate, resulted in very high cell cytotoxicity (LC50: 32.59 µg/ml) in compare to TAM or titanium silicate. This indicates that Tamoxifen alone or titanium silicate alone is not toxic to the cells, but when they conjugated together they show high activity against negative ER cells (HELA cells).

Conclusions: This study showed that titanium silicate enhance the delivery of TAM into cervical cells. In addition, resistant cancer cells to TAM that have low ER receptors can be treated with TAM + titanium silicate nanoparticles.

Key-words: HELA, TAM, titanium silicate, MTT assay, cytotoxicity.

Key Messages: The delivery of TAM into negative or low ERs cells requires TAM conjugation to titanium silica.

*Corresponding Author:
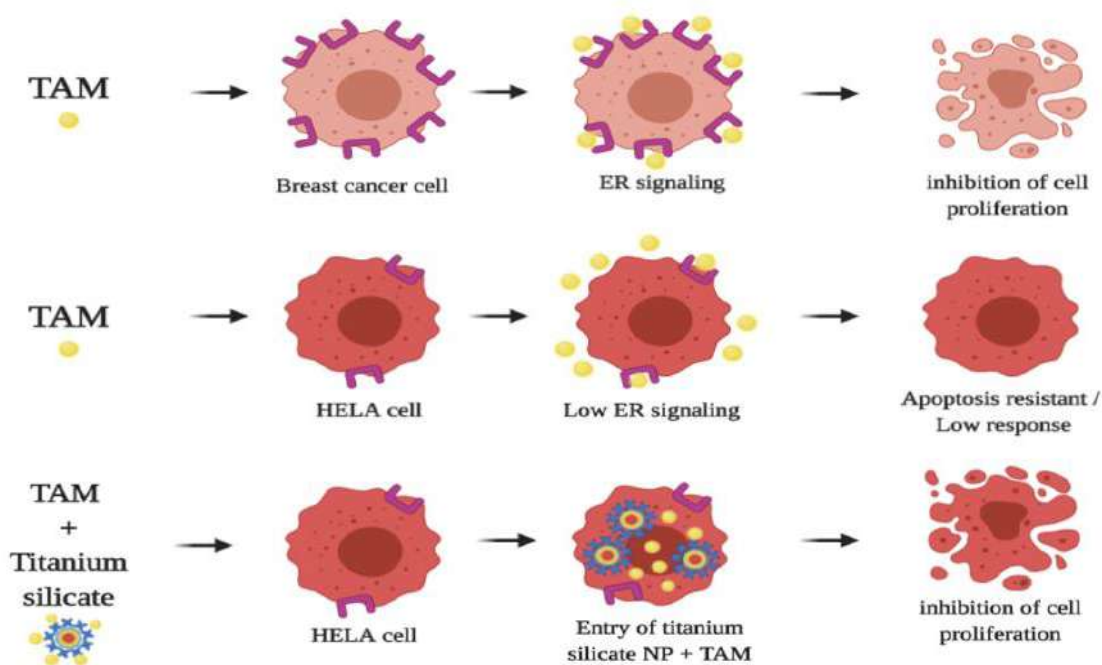Dr. Munther Alomari,
Department of stem cell research, Institute for Research and Medical Consultations
(IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
ORCID ID: https://orcid.org/0000-0001-5705-2926
Phone: 00966596667991   Email: maomari@iau.edu.sa

Graphical abstract

Titanium silicate nanoparticles enhance in the sensitivity of cervical cancer cells to Tamoxifen

IRMC-SRP-2020-08

Effect of magnetic iron oxide (Fe$_3$O$_4$) nanoparticles on germination, growth, and photosynthesis in barley (Hordeum vulgare L.) grown under constant magnetic field

Raghdah Atiah Alshumrani**,** Huseyin Tombuloglu

[1]Department of Genetic Research, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
[2]College of Sciences Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.

Abstract

Background: Recently, iron oxide (Fe$_3$O$_4$) nanoparticles (NPs) has become a source of interest to many scientists and researchers because of its unique characteristics such as its super magnetism, large surface area, ease of synthesis and separation. Magnetic fields could affect the metabolism and the growth rate of the plant depending on the magnet type, density of the magnetic field, orientation, polarity and exposure duration.

Objectives: The objective of this research is to investigate the effect of magnetic (Fe$_3$O$_4$) nanoparticles on germination, growth, and photosynthesis in barley (Hordeum vulgare L.) grown under constant magnetic field.

Methods and Material: Five different magnetic fields (0MT (control), 22MT, 42MT, 125MT, 550MT) were applied on barley seeds (n=100). The seeds were soaked either in nutrient solution (without NPs) or nutrient solution with 500 mg/L of NPs. After (3, 4, 7, and 12) days of exposure the root and shoot lengths were measured. The photosynthetic analysis was carried out by using PAM (pulse-amplitude modulation) fluorometer, and protein, and pigment level were detected by using spectrophotometer. A confocal microscope was used to observe the possible cell damage on root tips.

Results and discussion: Overall, the length of the roots and shoots in all NPs treated samples is longer than the untreated ones, except in 550MT, which found the magnetic field dose as toxic. By conducting photosynthesis analysis we found that the Fv\Fm (variable fluorescence by maximum fluorescence) decreases in the samples treated with NPs; this means that Photosystem II's efficiency decreases while Photosystem I is open. In addition, the light-adapted parameter ETR (electron transport rate) in samples treated with NPs increased.
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Conclusions: Even under a strong magnetic field, iron oxide (Fe_3O_4) nanoparticles demonstrated a strong influence in stimulating plant growth and development. Magnetic fields had a slight, mainly negative impact on the germination rate and parameters of germination in barley.

Key-words: Iron oxide, Nanoparticles, Magnetic field, Barley , magnetite

Key Messages: Since barley seeds are exposed to the nanoparticle (Fe_3O_4) under a persistent magnetic field, growth of seedlings and metabolisms are stimulated.
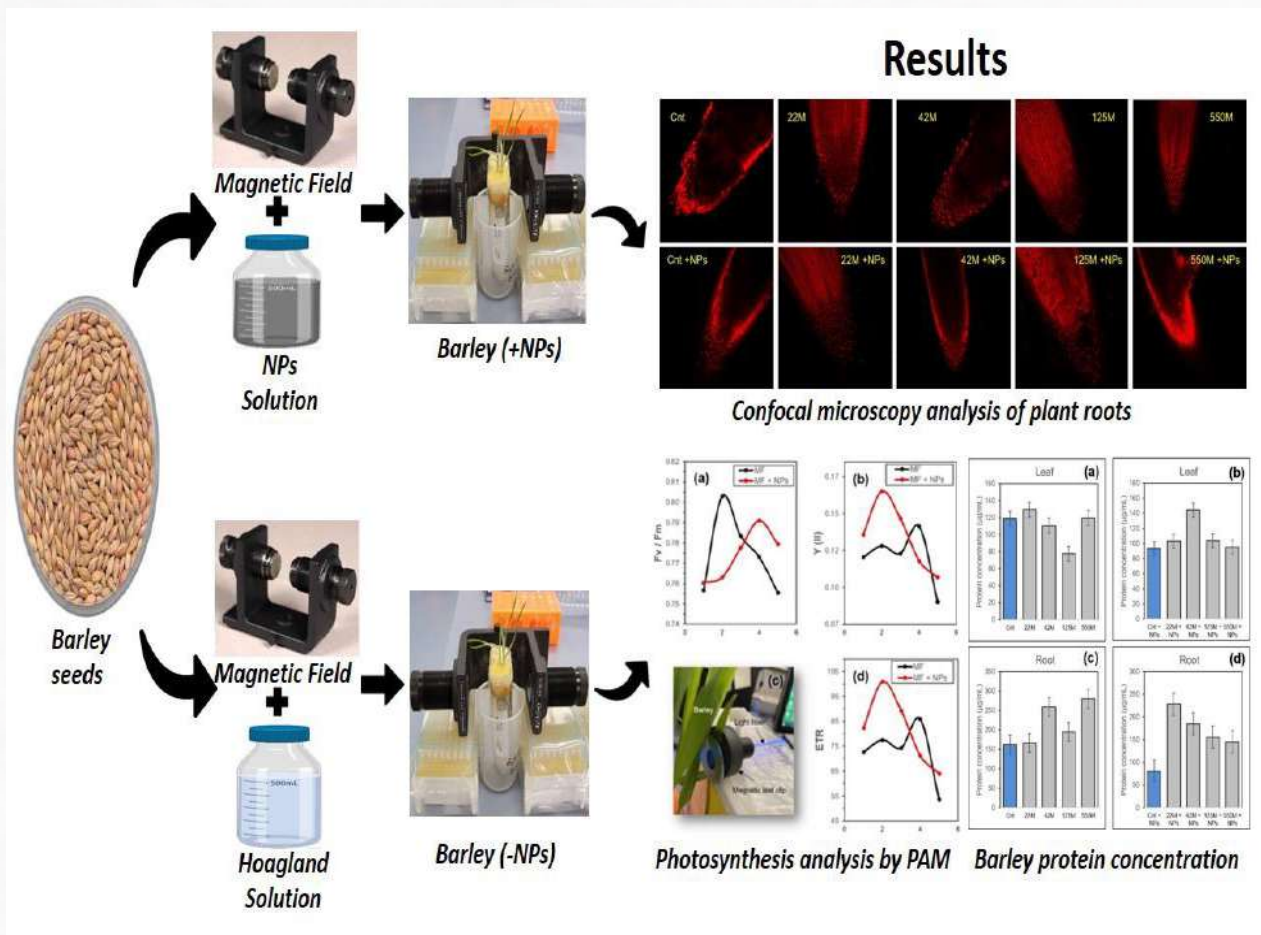
*Corresponding Author:
Name of the mentor, **Huseyin Tombuloglu**
Department of **Genetics** Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
ORCID ID: **http://orcid.org/0000-0001-8546-2658**
Phone: **30873** Email: htoglu@iau.edu.sa

Graphical abstract

IRMC-SRP-2020-09
The Effect of Magnetic Latex Nanoparticles (St+DVB+MMA) on Cervical Cancer Proliferation

Nora Khalid AlSudairi[1,2], Munther Alomari[1*]

[1]Department of Stem Cell Biology, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
[2]College of Science, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.

Abstract

Background: Magnetic nanoparticles (MNPs) have been widely used in cancer diagnosis and treatment. MNPs are particularly very small in size but of a large surface area for a better magnetic response which makes this type of nanoparticles very useful in tumor treatment.

Objectives: To evaluate the effect of superparamagnetic nanoparticles (core-shell (styrene (St)+ divinylbenzene (DVB)+ methacrylic acid (MAA))) on the drug resistant cervical cancer cells (HELA).

Methods and Material: The average hydrodynamic size of the MNPs was determined by A Malvern Zetasizer and the surface structure was characterized by TEM. Human cervical cancer cells (HELA (1.5×10^4)) were cultured in DMEM medium and exposed to various doses of the MNPs (0, 25, 50, 100, 200 and 400 µg/mL) for 24 and 48h. The effect of the MNPs was observed on HELA by optical and confocal microscopes and MTT cell viability assay. The resulted MTT data were subjected to statistical analysis (T-Test).

Results and discussion: The hydrodynamic particle size of the final magnetic latex particles was found to be around 400 nm and the zeta potential is negative. In addition, confocal microscopy pictures showed high entry of MNPs into the cells with low cytotoxicity after 24h of treatment, this indicates that these MNPs may be used for cancer imaging. In vitro study of the latex MNPs showed high cytotoxicity in a dose-dependent matter against cervical cancer cell line HELA. The 24h treatment showed significant effect with very low margin difference between the lowest and highest treatment concentrations. On the other hand, at 48h treatment the MNPs cytotoxicity increased with the concentration to reach 58% at 400 µg/mL.

Conclusions: In summary, the MNPs was significantly effective against cervical cancer cells proliferation after 48h of treatment. In addition, latex MNPs showed easy

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Nora Khalid AlSudairi[1,2], Munther Alomari[1*]

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Conclusions: In summary, the MNPs was significantly effective against cervical cancer cells proliferation after 48h of treatment. In addition, latex MNPs showed easy

access to HELA cells which is a characteristic that can overcome cervical cancer cells resistance.

Key-words: Superparamagnetic nanoparticles; cervical cancer; HELA; Cytotoxicity; proliferation.

Key Messages: Superparamagnetic nanoparticles (core-shell (St+ DVB + MAA)) is effective against HELA cells with low concentration of treatment (50 µg/mL) after 48h.

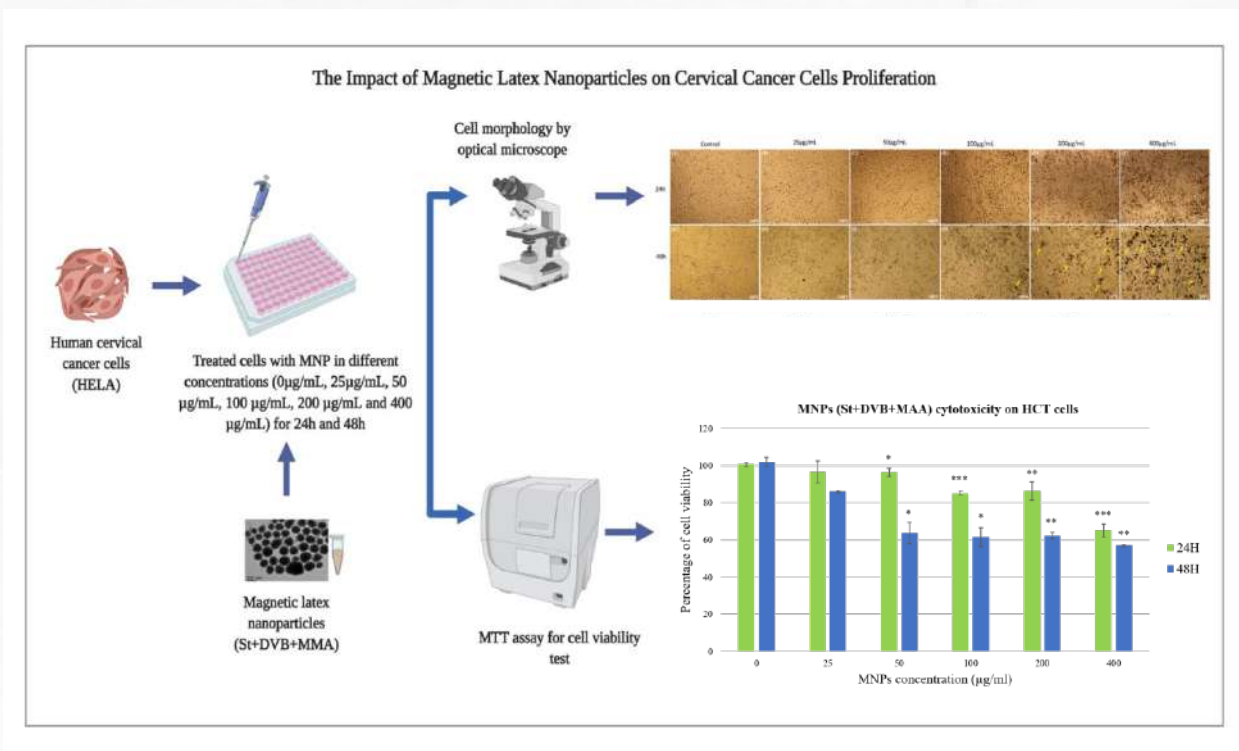***Corresponding Author:**
Dr. Munther Alomari,
Department of stem cell research, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
ORCID ID: https://orcid.org/0000-0001-5705-2926
Phone: 00966596667991   Email: maomari@iau.edu.sa

Graphical abstract

The Impact of Magnetic Latex Nanoparticles on Cervical Cancer Cells Proliferation

Effect of magnetic iron oxide (Fe_3O_4) nanoparticles on germination, growth, and photosynthesis in barley (*Hordeum vulgare* L.) grown under constant magnetic field

Muruj Abdullah Bamuhriz [1,2], Huseyin Tombuloglu [1*]

[1]Department of Genetic Research, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
[2]College of Science, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.

Abstract

Background: Recently, many studies are based on nanoparticles, which are any molecule with a size range from 1 to 100 nm. It gives a powerful and positive result when used, although researchers do not know for sure their side effects on living beings such as humans.

Objectives: This study aimed to investigate the effect of Fe_3O_4 nanoparticles on germination and photosynthesis in barley (*Hordeum vulgare* L.) under different magnetic field conditions.

Methods and Material: Five magnetic fields were prepared (0 MT (control), 22MT, 42MT, 125MT, 550MT). Then, 100 seeds of barley were distrusted into ten petri dishes; five of them were imbibed in nutrient solution with NPs (500 mg/L) and the rest in the nutrient solution exempt from NPs. Afterwards, the plates were placed under magnetic field. The root and shoot length were measured after 3, 4, 7, and 12 days of exposure. Photosynthetic parameters were determined by using PAM (pulse-amplitude modulation) fluorometer; protein and pigment detection were performed by using a spectrophotometer; and a possible cell damage in the root tips was observed by using confocal microscopy.

Results and discussion: In general, roots and shoots length in all NPs treated samples are longer than the non-treated ones. Even in 550MT, which considered as toxic for the plant growth. The fluorescence analysis of the dark-adapted plants revealed that the Fv\Fm (variable fluorescence by maximum fluorescence) is decreasing in NPs treated samples, meaning that the efficiency of photosystem II decreases and photosystem I opens. Moreover, the light-adapted parameter ETR (electron transport rate) increased in NPs treated samples.

Conclusions: Iron oxide (Fe_3O_4) nanoparticles showed a potent effect in stimulating plant growth even under a high magnetic field.

Keywords: Nanoparticles; Iron oxide (Fe_3O_4); Magnetite; Magnetic field; barley (Hordeum vulgare L.).

Key Messages: The exposure of barley seeds by the nanoparticle (Fe_3O_4) under a constant magnetic field increased germination, and the seedlings growth.

*Corresponding Author:
Dr. Huseyin Tombuloglu,
Department of Genetic Research, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
ORCID ID: 0000-0001-8546-2658,
Phone: +966 350725817 Email: htoglu@iau.edu.sa

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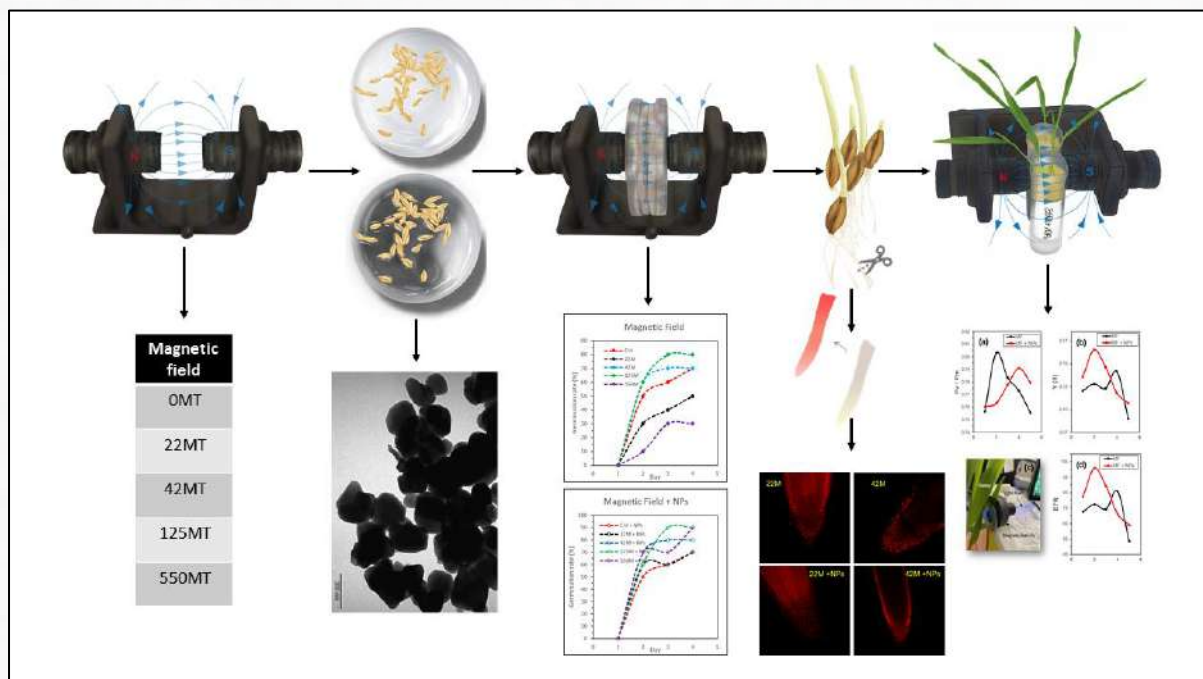
IRMC-SRP-2020-11

The impact of variations in *DRD2* gene on the structure of DRD2 protein and interaction with risperidone: A pharmacogenetics study

Fatimah Dheem Aldosari[1,2], Hind Saleh Alsuwat[1], Noor B Almandil[3], Abdulla AlSulaiman[4], Sayed AbdulAzeez[1], J. Francis Borgio[1]

[1]Department of Genetic Research, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
[2]College of Pharmacy, Princess Nourah Bint Abdulrahman University, Riyadh, Saudi Arabia.
[3]Department of clinical Pharmacy Research, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
[4]Department of Neurology, College of Medicine, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.

Abstract

Background: There has been extensive research on Dopamine receptor subtype D2 gene that takes part in dopaminergic pathway. Recent studies highlighted the importance of genetic variants and its possibility to modulate the neuropsychiatric response to risperidone drug but there was no specific predictable genetic marker has been identified as of yet

Objectives: To determine the most effective amino acid substitutions on the structure of mutated DRD2 protein, and asses its influence on the docking of risperidone molecule to their receptor on DRD2.

Methods and Material: A total of 18671 genetic variants of *DRD2* gene have been retrieved from NCBI (National Center for Biotechnology Information), variants identified through DNA exome microarray and DNA sequencing of Saudi autistic patient, and analyzed via in silico tools (SIFT, SNAP, PolyPhen-2, PANTHER, PROVEAN, SNPs&GO, and PhD-SNP) to predict the most pathogenic non-synonymous SNPs (nsSNP). The most pathogenic and variants from Saudi subjects were subjected for docking with risperidone molecule to on wild and mutant DRD2.

Results and discussion: Rigorous in silico analysis predicted the most 16 pathogenic nsSNPs based on cumulative score generated using 7 tools, one nsSNPs prevalent in Saudis was also added. The 17 variants selected were found to be structurally deviated to wild calculated by root mean square deviation (RMSD), and C126W (RMSD 0.07 Å) showed highest changes. Out of the 17 amino acid substitutions F198C (S score: -7.0752 kcal/mol) showed highest deviation in the binding affinity compare to the wild (S score: -7.5381 kcal/mol) on the structure-based docking with risperidone using MOE on the binding packets at the active site.

Conclusions: Highly pathogenic genetic variants of *DRD2* gene influence the binding affinity of risperidone and that could be one of the reasons to explain the inter-individual variation in neuropsychiatric response efficacy and toxicity in different patients based on their *DRD2* genotype.

Key-words: Dopamine D2 receptor, Risperidone, Autism, Saudi Arabia population, Drug docking, Non-synonymous SNPs.

Key Messages: The genetic nature of *DRD2* gene might play important role on neuropsychiatric response. In this study, this gene showed various binding affinity. We examined that those variation could affect risperidone efficacy and toxicity.

*Corresponding Author:

Dr. Sayed AbdulAzeez, Department of Genetic Research, Institute for Research and Medical Consultation (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia. Mobile: 0549950035. ORCID ID: http://orcid.org/0000-0002-9763-9446
Email: asayed@iau.edu.sa

Graphical abstract

The impact of variations in *DRD2* gene on the structure of DRD2 protein and interaction with risperidone: A pharmacogenetics study
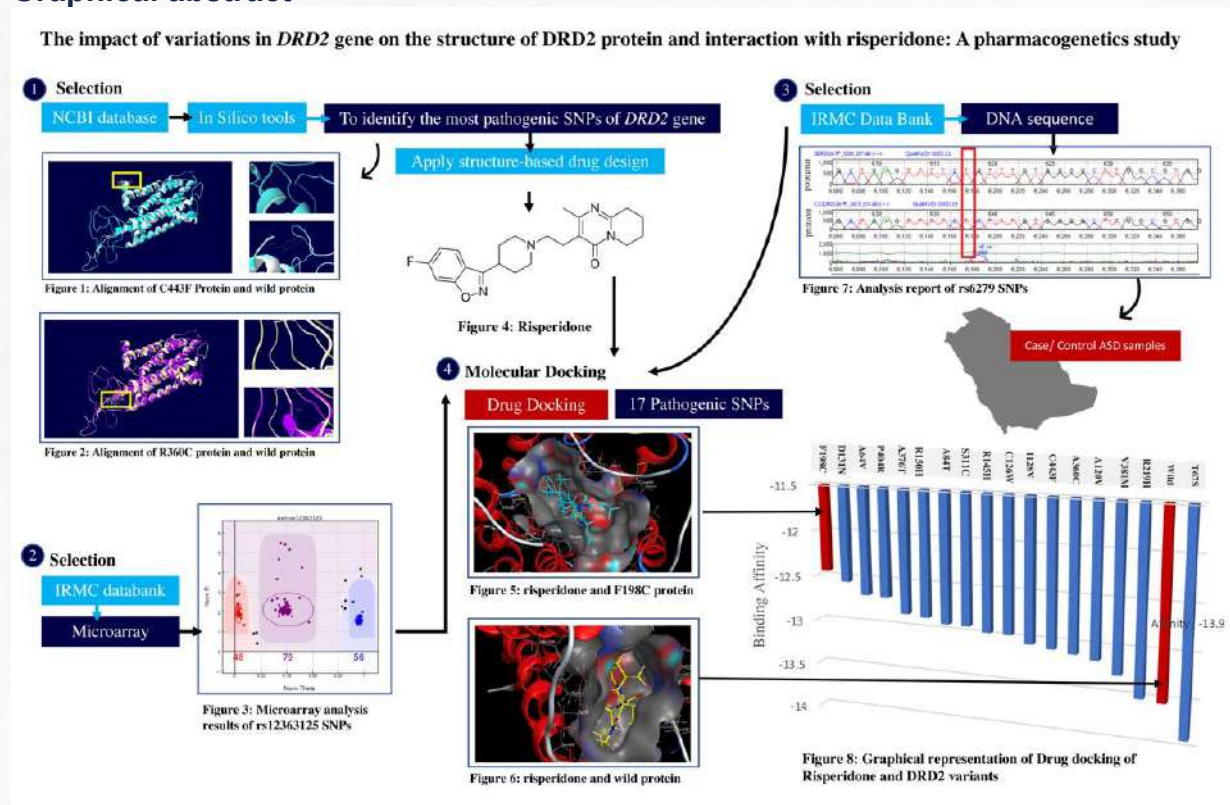
IRMC-SRP-2020-12
Exploring the underlying mechanism of Tocilizumab in SARS-CoV-2

Rawan Mohammad Alharbi [1,2], Adeeb Shehzad [1]

[1]Department of Clinical Pharmacy, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
[2]Department of Biochemistry, College of science , King Abdul Aziz University, Jeddah, Saudi Arabia.

Abstract

Background: A new coronavirus was identified with the name 2019-nCoV \ SARS-CoV-2, responsible for worldwide epidemic. There is stimulation of inflammatory cytokines was seen during the acute phase of infection. Tocilizumab known as humanized IL-6-blocking treatment given for chronic autoimmune diseases or connective tissue disease and it may be beneficial and prevent the development of severe COVID-19 symptoms in selected patients.

Objectives: Various therapeutic strategies have been practiced for decreasing COVID-19 symptoms. The aim of current study was to assess the therapeutic role of tocilizumab in reducing the life-threatening effect COVID-19 in patients by reducing their level of IL-6.

Methods and Material: A PRISMA based protocol was used for collection of various articles and press release. English language articles were selected from pubmed, scopus, Medline and Google Scholar readily published from 15th January 2020 to 20th July 2020. The search terms included combinations of SARS, CORONA, SARS-COV-2, cytokine storms, antiviral, IL-6 and Tocilizumab.

Results and discussion: Cytokines have a significant role in immune response, and in this study, we have shown that IL-6 might play a key role in the cytokine storm. IL-6 is one of the important inducers of the acute-phase response. Interfering with IL-6 by Tocilizumab might be a promising therapeutic drug for severe COVID-19 patients. Tocilizumab is a humanized anti-IL-6R antibody, which acts by blocking the IL6 receptor, consequently replacing IL6 receptor. Several animal models and human studies have reported that tocilizumab treatment significantly reduced the severity of COVID-19 pneumonia and associated symptoms.

Conclusions: Tocilizumab has the ability to block COVID-19-induced cytokine storm by modulating including releasing of pro-inflammatory interleukin-6 (IL-6), tumor necrosis factor-α (TNF-α), and IL-12 in COVID-19 patients.

Keywords: SARS-CoV-2, IL6, Tocilizumab, antiviral, inflammation

Key Messages: Tocilizumab abrogates the cross-linking signalling between cytokine storm and SARS-COV-19 by inhibiting inflammatory cytokines.
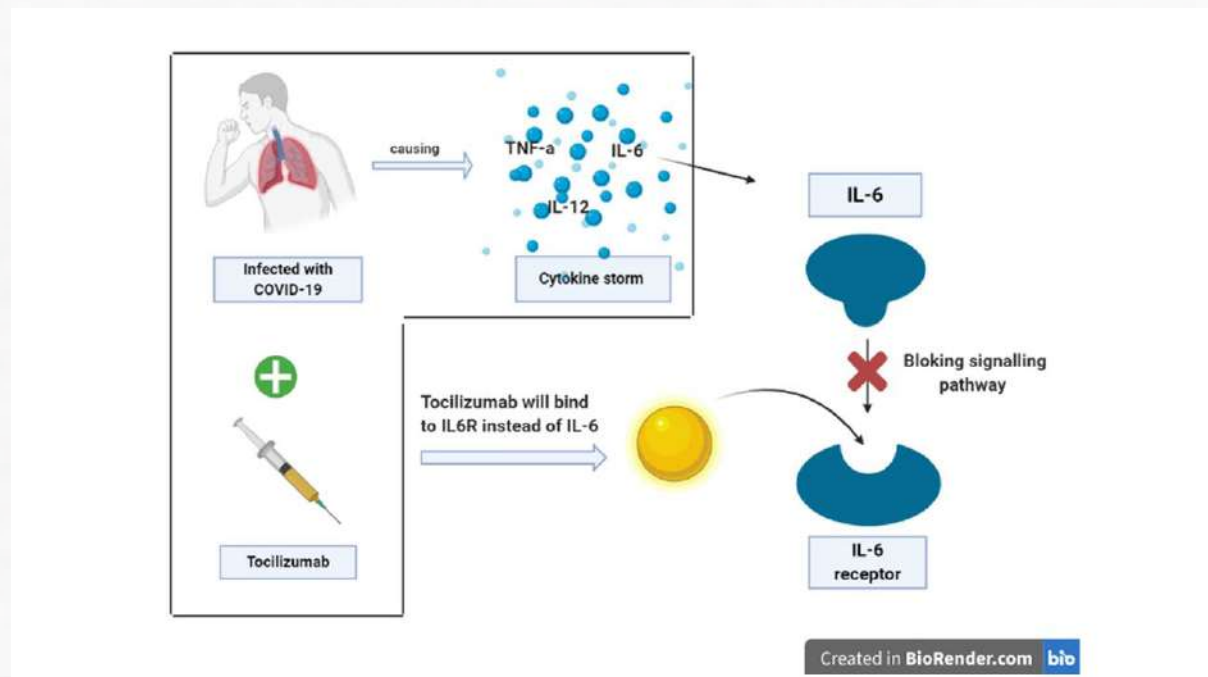
*Corresponding Author:

Dr Adeeb Shehzad
Department of Clinical Pharmacy, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
ORCID ID: https://orcid.org/0000-0003-1335-0571 Email: asmsiar@iau.edu.sa

Graphical abstract

IRMC-SRP-2020-13
In Silico **Approaches: The Emerging of Composition Variations of SARS-CoV-2 Spike Protein and Human ACE2 Contribute to the level of Infection**

Norah Ali AlGhamdi[1,2], Hind Saleh Alsuwat[1], Sayed AbdulAzeez[1], J. Francis Borgio[1,3*]
[1]Department of Genetic Research, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
[2]College of Science, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
[3]Department of Epidemic Diseases Research, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam 31441, Saudi Arabia.

Background: SARS-CoV-2 is causative of pandemic COVID-19, There is a sequence similarity between SARS-CoV-2 & SARS-CoV, however, SARS-CoV-2 RBDs (receptor-binding domain) binds 20 fold strongly with human angiotensin-converting enzyme 2 (hACE2) than SARS-CoV.

Objectives: The study aims to investigate protein–protein interactions (PPI) of hACE2 with SARS-CoV-2 RBD between wild and variants to detect the most influential interaction.

Methods: Variants of hACE2 were retrieved from NCBI databank, and subjected to determine the most pathogenic nsSNPs. Probability of PPIs determines the binding affinity of hACE2 genetic variants with RBD were investigated. Composition variations at the hACE2 and RBD were processed for PatchDock and refined by FireDock for the PPIs.

Results and Discussion: Twelve nsSNPs were identified as the top pathogenic from SNPs (n=7489) in *hACE2* using 8 bioinformatics tools. Eight RBD variants were complexed with 12 nSNPS of hACE2, the global energy scores (Kcal/mol) were calculated and classified as very weak (-3.93 to -18.43), weak (-18.42 to -32.94), moderate (-32.94 to -47.44), strong (-47.44 to -61.95), and very strong (-61.95 to -76.46) zones. Seven composition variants in the very strong zone [G726R-G476S; R768W-V367F; Y252N-V483A; Y252N-V367F; G726R-V367F; N720D-V367F and N720D-F486L], and three in very weak [P263S-S383C; RBD-H378R; G726R-A348T] are significantly ($p<0.00001$) varied for global energy score.
Conclusions: Zonation of the five zones were established based on the scores to differentiate the effect of hACE2 and RBD variants on the binding affinity. Moreover, our findings support that the combination of hACE2 and RBD are key players for the risk of infection that should be done by further laboratory studies.
Key-words: SARS-CoV-2, ACE2, Protein Docking, In silico Software, nsSNPs.

Key Messages: SARS-CoV-2 Spike protein interacts with human ACE2 proteins irrespective of their combination of Variations. Severe combinations of variants have

been reported. Thus, we need to focus more on the possibility of further genetics studies for utilizing zones for controlling COVID-19.

*Corresponding Author:

Dr. J. Francis Borgio, Department of Genetic Research, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia. ORCID ID: (COVID19-2020-007-IRMC) https://orcid.org/0000-0001-7199-1540

Phone: 00966 13 3330864, Email: fbalexander@iau.edu.sa.

Graphical abstract
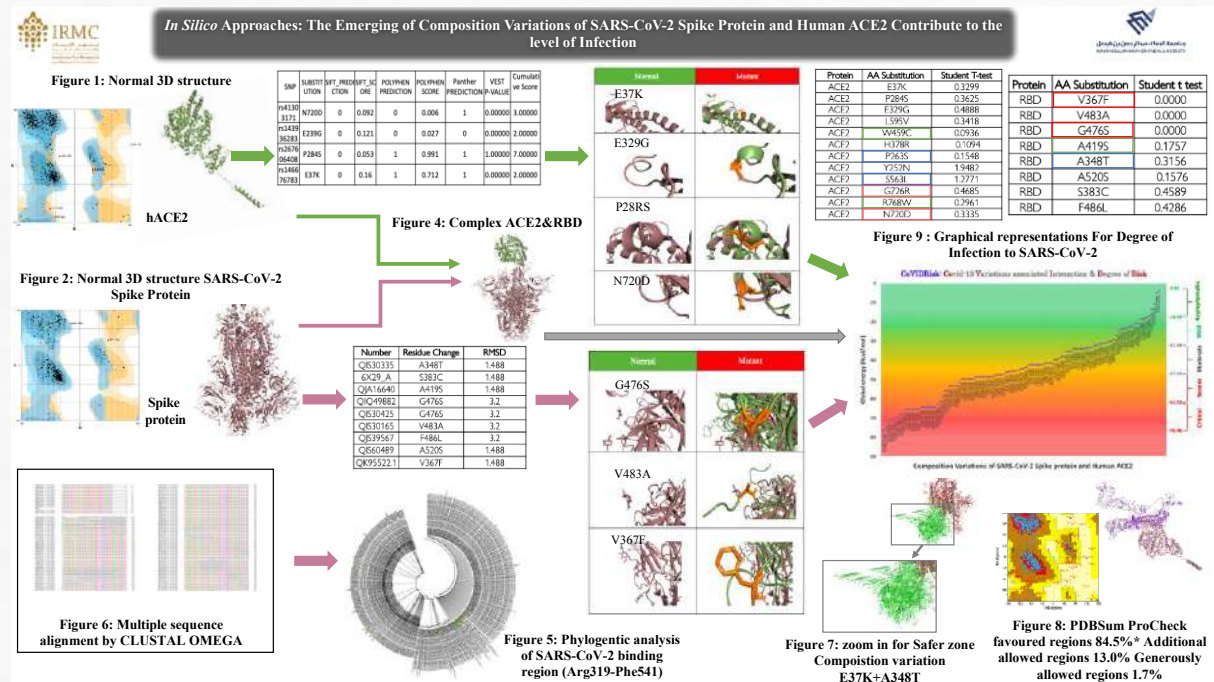
| Abstracts from Computational Modeling |

IRMC-SRP-2020-14
DFT study to calculate the adsorption of 5-Fluorourcil on h-BN sheet

Hussah Ahmed Aldossary [1,2], Ahmed Maarouf [1*]

[1]Department of Biophsics Research, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
[2]College of science , Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.

Abstract

Background: Hexagonal boron nitride (h-BN) have a crystal structure analogous to graphene with sp^2 hybridized structure.

Objectives: In this project, we use density functional theory (DFT) to study the electronic properties of hexagonal boron nitride (h-BN) structures.

Methods and Material: We use DFT, with two flavors, local density approximation (LDA), and generalized gradient approximation (GGA) to calculate the electronic properties of h-BN.

Results and discussion: The density of states (DOS) of both calculations are generally similar The band gap is found to be 4.32 eV for LDA and 4.5 eV for GGA. We then construct a 2x2 h-BN unit cell, having 8 atoms, and dope the system with carbon, at a N site, and a B site. We find that the gap decreases to 3.89 eV former, and to 3.91 eV to the latter. As an application to our study, we are now investigating the adsorption of the cancer drug FU on h-BN. To do that, we constructed a large 6x6 h-BN unit cell, and placed the FU molecule on it at a distance of 3 A. The system is structurally relaxed.

Conclusions: currently calculating the adsorption properties of FU on h-BN and carbon doped h-BN. Preliminary results indicate that FU adsorbs on h-BN with an energy of 0.38 eV. Doping BN with carbon and Aluminum is currently being studied. The calculations will be run on the supercomputing cluster of IAU. We will report the results once they are finished.

Key-words: DFT, hexagonal boron nitride, electronic properties, LDA, 5-fluorouracil

Key Messages: the study aims to measure specific properties for h-BN to be able in the future to take benefits of the properties to help different industries
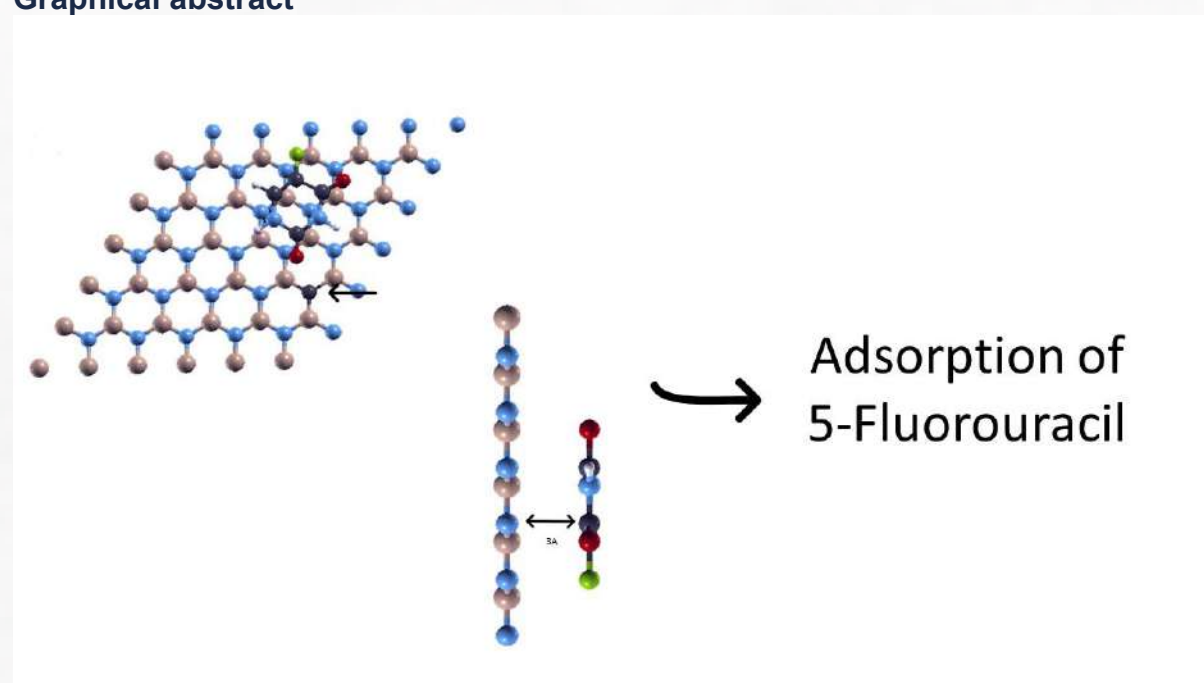
*Corresponding Author:
Ahmed Maarouf,
Department of biophysics, Institute for Research and Medical Consultations (IRMC),
Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
ORCID ID: https://orcid.org/0000-0003-4546-7862
Phone: 0591066650 Email: amaarouf@iau.edu.sa

Graphical abstract

Machine Learning and Deep Learning Based Diagnosis for COVID-19 Using Chest X-Ray Images

Amaal Ghazi AlOtaibi [1,2], Maha Al-Shammari[1*], Lubna Ibrahim Al Asoom[3], J. Francis Borgio[4,5]

[1]Computational Unit, Department of Environmental Health, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam 31441, Saudi Arabia
[2]College of Computing and Informatics, Saudi Electronic University, Dammam, Saudi Arabia.
[3]Department of Physiology, College of Medicine, Imam Abdulrahman Bin Faisal University Dammam, Saudi Arabia
[4]Department of Genetic Research, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
[5]Department of Epidemic Diseases Research, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam 31441, Saudi Arabia.

Abstract

Background: In March 2020 World Health Organization announced that COVID-19 is Pandemic due to fast infection between people. To control the spread of COVID-19 governments take measurements by applying active scanning to identify COVID-19 patients. One of the considered fast screening tools to diagnose COVID-19 patients is using Chest X-ray images. For the chest X-ray images, there are many views, the most frequently used are posteroanterior (PA) and anteroposterior (AP). The effectiveness of diagnosis can be increased by using Machine Learning and Deep Learning models for predicting SARS-CoV-2 viral infection through chest X-ray images that are scanty.

Objectives: This study aims to classify chest X-ray images to predict SARS-CoV-2 viral infection using Machine Learning and Deep Learning models.

Methods and Material: In this study, the size of the dataset is 134 chest X-ray images with 76 confirmed COVID-19 cases. The Machine Learning Model include K-Nearest Neighbors (KNN), and Support Vector Machine (SVM) methods along with Fiji ImageJ software and use of the correlation function. The Deep Learning Model includes Convolutional Neural Network (CNN) method. Each model was able to classify X-ray images as positive or negative COVID-19.

Results and discussion: The evaluation of Machine Learning and Deep Learning models based on 70%-30% of the chest X-ray images for the training and testing the models. The KNN method with 9 n_neighbors parameters and SVM method with linear kernel and auto gamma parameters show a similar accuracy result with 95% and 98% respectively for the normal and COVID-19 cases. The best performance obtained for CNN with 100% accuracy.

Conclusions: The study demonstrated the performance of the Machine Learning Model and Deep Learning Model in analyzing and classifying chest X-ray images based on the accuracy of the models.

Key-words: K-Nearest Neighbors, Support Vector Machine, Convolutional Neural Network, Posteroanterior View, Python Programming Language, Features Extracting.

Key Messages: By comparing Machine Learning and Deep learning models we found that Deep Learning Model using the Convolutional Neural Network method is more accurate in analysing the chest X-ray images to screen SARS-CoV-2 viral infection.

*Corresponding Author:
Maha Al-Shammari,
Computational Unit, Department of Environmental Health, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.ORCID ID: https://orcid.org/0000-0002-2384-8691
Phone: 00966555899115 Email: mmashammari@iau.edu.sa

Graphical abstract
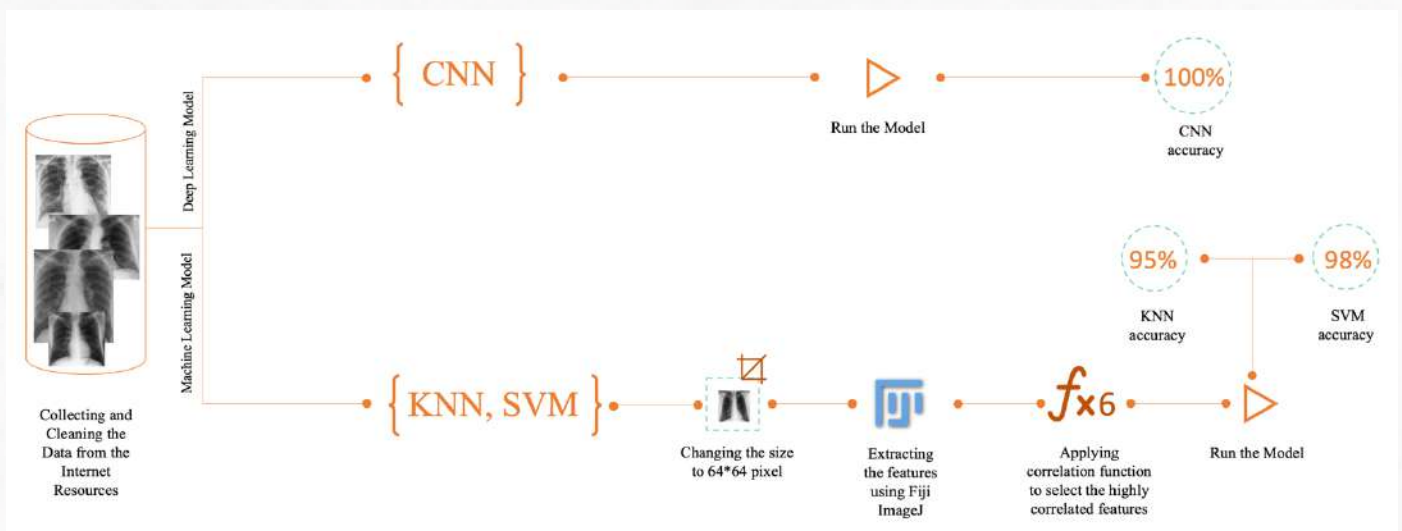
IRMC-SRP-2020-16
Linear Regression Analysis for SARS-CoV-2

Dalal Abdulrahman Alghamdi [1,2], Maha M. AlShammari [1*]

[1]Computational Unit, Department of Environmental Health, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam 31441, Saudi Arabia.
[2]Department of Mathematics, College of Science, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.

Abstract

Background: SARS-CoV-2 caused COVID-19 pandemic originated at the end of 2019 in Wuhan city in China. Until now there is no valid treatment or vaccine. The current strategy in order to prevent the infection spread out is included: keep a social distance and rapidity of scientific producing of effective diagnostic tools and medications.

Objectives: To calculate the lung infection rate by x-ray images and determine the strength of the relationship between lung infection rate and patient records (if there are chronic diseases, age, and gender) of SARS-CoV-2.

Methods and Material: This study included 80 SARS-CoV-2 patients. Data were collected and cleaned in Microsoft Excel 2019 software. Used ImageJ software to extract the density of X-ray images to calculate the lung infection rate. Loaded data into R 4.0.2 software to implement a linear regression analysis to determine the strength of the relationship between lung infection rate and patient records.

Results and discussion: Linear regression analysis showed that the relationship between lung infection rate with if there are chronic diseases gives: p-value = 0.521, 95% CI: (-4.72, 9.23), with age gives: p-value = 0.525, 95% CI: (-0.28,0.15), with gender gives: p-value = 0.693, 95% CI: (-8.02, 5.35). So, since p-value > 0.05 we will accept the null hypothesis which said that there no significant differences between lung infection rate and (if there are chronic diseases, age, and gender).

Conclusions: According to our analysis, there is no strength of the relationship between lung infection rate and if there are chronic diseases, age, and gender.

Keywords: Regression, Coronaviruses, Infection rate, Pandemic, Lung.

Key Messages: By implement linear regression analysis between lung infection rate and the patient records. We find that there is no strong relationship between them.
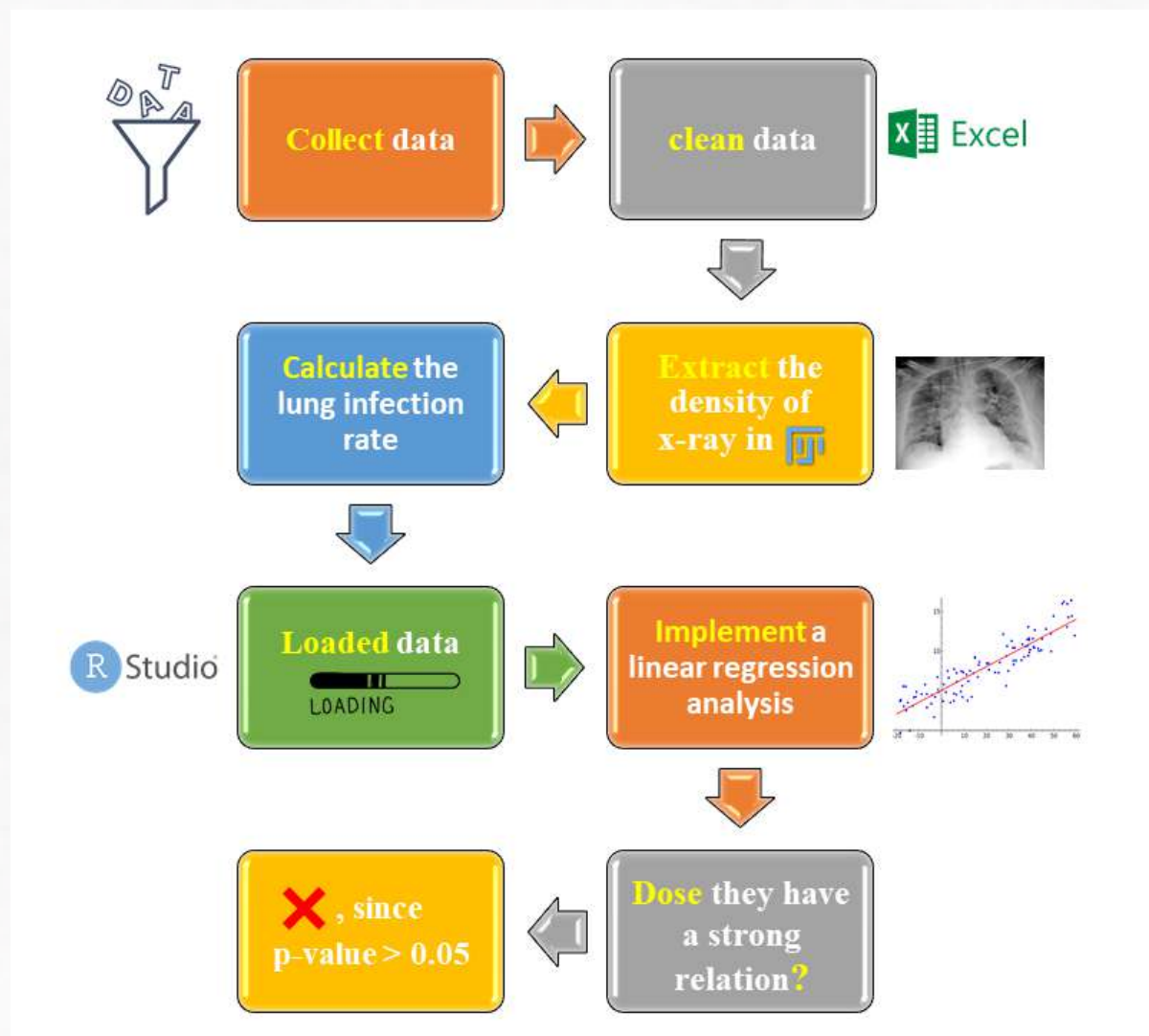
*Corresponding Author:
Maha Mansour Alshammari,
Department of Environmetal Health Research, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
ORCID ID: https://orcid.org/0000-0002-2384-8691.
Phone: 0555899115.
Email: mmashammari@iau.edu.sa .

Graphical abstract

IRMC-SRP-2020-17
Deep Learning Vs.Machine Learning Based Screening of COVID-19 Using Chest X-Ray Images.

Norah Abdulraheem Alzahrani [1,2], Maha Al-Shammari[1*], Lubna Ibrahim Al Asoom[3], J. Francis Borgio[4,5]

[1]Computational Unit, Department of Environmental Health, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam 31441, Saudi Arabia.
[2]College of Computer Science and Information Technology, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
[3]Department of Physiology, College of Medicine, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
[4]Department of Genetic Research, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
[5]Department of Epidemic Diseases Research, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam 31441, Saudi Arabia.

Abstract

Background: COVID-19 pandemic affected many countries worldwide; the latest recorded number was 14 million confirmed cases. Some studies experiment on using deep learning models to diagnose COVID-19 using medical imaging such as chest X-ray (CXR) images. However, the use of deep learning and machine learning are limited.

Objectives: This study aims to classify the CXR images into normal or COVID-19 using deep learning and machine learning and comparing the two techniques.

Methods and Material: Our dataset contains 143 images of posteroanterior view CXR for normal (n=67) and COVID-19 cases (n=76), 100 images for training, and 43 for testing. We used the Python programming language to implement the deep learning model to build and evaluate the Convolutional Neural Network (CNN) model. For the machine learning model, we first extract 36 features using Fiji ImageJ tool. We then used these features to build KNN and SVM models in python. We used features selection and parameter tuning to produce better results for the models.

Results and discussion: The deep learning model achieved an accuracy of 100% using the CNN model. Whereas, machine learning produced 95% for KNN when it had two features. Where the SVM model achieved 98%, and it had one feature. From the results, we found that the deep learning model outperforms the other two machine learning models.

Conclusions: To conclude, the deep learning model using CNN achieved better results than machine learning for classifying CXR either to COVID-19 cases or normal. Future studies may focus on experimenting using a larger dataset for CXR.

Key Messages: A comparison study between machine and deep learning in COVID-19 and normal CXR images. We found that deep learning achieved a better result than machine learning using the CNN method. We created a simple screening protocol for COVID-19 based on chest X-ray Images.

*Corresponding Author:
Maha Al-Shammari,
Computational Unit, Department of Environmental Health, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
ORCID ID: https://orcid.org/0000-0002-2384-8691
Phone: 966555899115 Email: mmashammari@iau.edu.sa

Graphical abstract
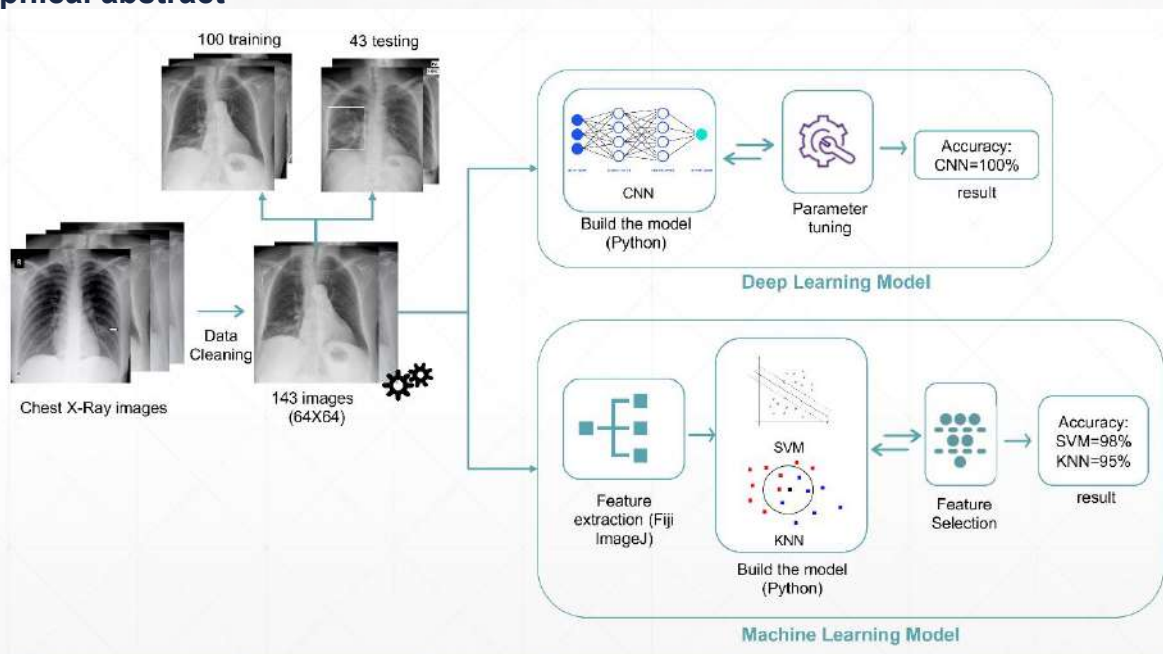
Title: COVID-19 Screening Based on Chest X-Ray Images Using Deep Learning and Machine Learning

| Abstracts from Nanotechnology |

IRMC-SRP-2020-18
Synthesis and Characterization of Magnetoelectric
$BaTiO_3/Co_{0.5}Ni_{0.5}Nb_{0.02}Fe_{1.98}O_4$ Nanocomposites for Multifunctional Device Applications

Nouf Essa Aldossary [1,2], Yassine Slimani [1*], Abdulhadi Baykal [3]

[1]Department of Biophysics Research, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
[2]Department of Applied Chemistry, College of Science, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
[3]Department of Nanomedicine Research, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.

Abstract

Background: Multiferroic materials have been extensively investigated and have directed to prominent technological applications. Most of the single-phase multiferroic materials have many drawbacks, such as the low remanent polarization, the very weak ferroelectric/ferromagnetic response, and the very low magnetoelectric coupling constant, etc. Magnetoelectric composite materials can overcome all these limitations. These materials have received much research interest and potential multifunctional applications, including ferroelectric photovoltaics, energy harvesters, nano-electronic devices, actuators, magnetic field and electric sensors, nonvolatile memory devices, storage devices, etc.

Objectives: We aim to synthesize magnetoelectric composites exhibiting better properties than single-phase multiferroic materials to be useful for multifunctional device applications.

Methods and Material: Magnetoelectric nanocomposites of $BaTiO_3$ added with different amounts of Nb substituted CoNi-ferrites were prepared. The ferroelectric $BaTiO_3$ nanopowders were firstly prepared via high energy ball milling technique. On the other hand, Nb substituted $Co_{0.5}Ni_{0.5}Nb_{0.02}Fe_{1.98}O_4$ nanosized spinel ferrite was synthesized via hydrothermal method. After that, ferroelectric and magnetic powder phases were mixed, compacted into pellets and then heat treated at high temperature. The magnetoelectric nanocomposites were examined using XRD, TEM, SEM, UV-vis DRS, VSM and Impedance analyzer techniques.

Results and discussion: The successful formation of the desired nanocomposites was confirmed by XRD patterns. XRD, SEM and TEM observations revealed the co-existence of the ferroelectric $BaTiO_3$ and the magnetic $Co_{0.5}Ni_{0.5}Nb_{0.02}Fe_{1.98}O_4$ phases in the produced nanocomposites. The microstructural changed affect greatly the optical, magnetic and dielectric properties of $BaTiO_3/Co_{0.5}Ni_{0.5}Nb_{0.02}Fe_{1.98}O_4$

nanocomposites. The present magnetoelectric composites could be potential candidates for multifunctional device applications.

Conclusions: The obtained findings revealed that the magnetoelectric $BaTiO_3$ + $x\%$ $Co_{0.5}Ni_{0.5}Nb_{0.02}Fe_{1.98}O_4$ nanocomposites could be potential candidates for multifunctional device applications.

Key-words: Magnetoelectric materials; $BaTiO_3$; Spinel ferrite; Microstructure; Magnetization; Dielectric properties.

Key Messages: Production of new magnetoelectric nanocomposites exhibiting enhanced properties compared to single-phase multiferroic materials to be useful for multi-functional device applications.
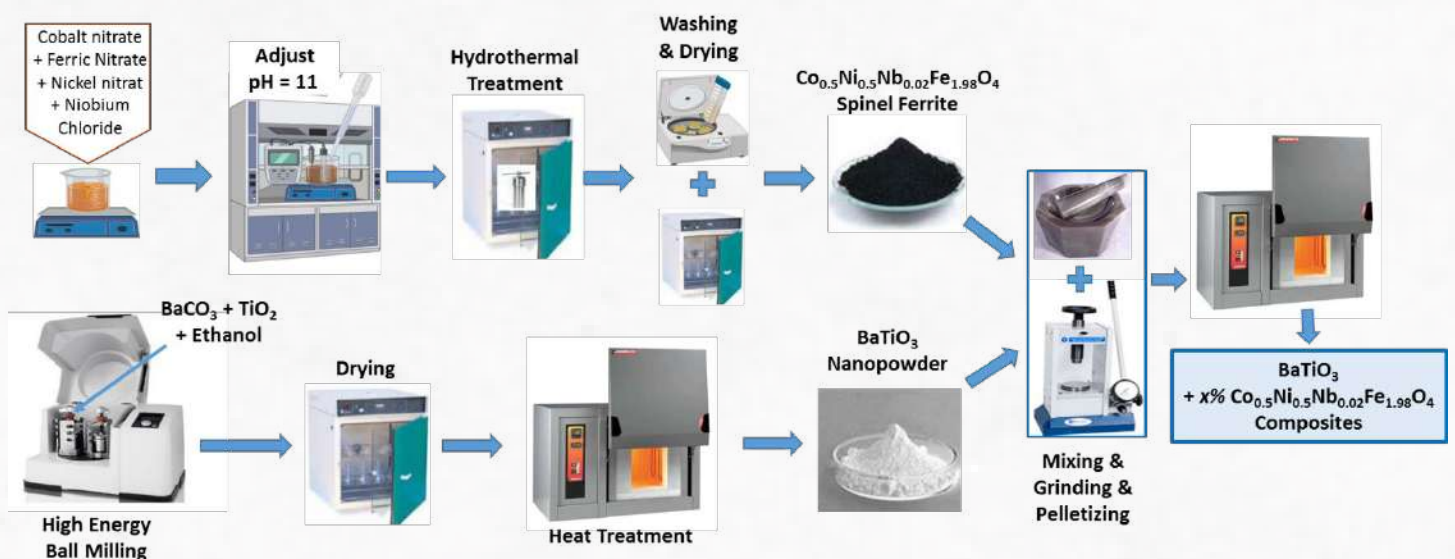
*Corresponding Author:
Yassine Slimani,
Department of Biophysics, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
ORCID ID: https://orcid.org/0000-0002-2579-1617,
Phone: 00966599658876; Email: yaslimani@iau.edu.sa

Graphical abstract

Design and Development of Hallow Carbon Spheres of $Ni_{0.5}Co_{0.5}Ce_xDy_xFe_{2-2x}O_4$ for microwave absorbing applications

Rawan Ali Alkhathaami [1,2], Yassine Slimani [1*], Abdulhadi Baykal [3]

[1]Department of Biophysics Research, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
[2]Department of Applied Chemistry, College of Science, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
[3]Department of Nanomedicine Research, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.

Abstract

Background: Plentiful attempts were performed in order to synthesize new promising microwave absorbing materials with enhanced performances. The family of spinel ferrites exhibits a set of outstanding specific properties including high saturation magnetization, smaller coercivity, and high thermal stability, which lead them promising in various fields ranging from high density magnetic recording media to microwave devices applications. Specific interesting characteristics involving electromagnetic waves absorption across a broad frequency band could be achieved via the combination of spinel ferrite magnetic nanoparticles and electrically conductive hollow carbon spheres.

Objectives: Our goal is to develop hollow carbon spheres of $Ni_{0.5}Co_{0.5}Ce_xDy_xFe_{2-2x}O_4$ (x = 0.04 - 0.06) for the use in microwave devices applications.

Methods and Material: Carbon spheres of $Ni_{0.5}Co_{0.5}Fe_{2-2x}Ce_xDy_xO_4$ (where x = 0.04 and 0.06) were produced through sonochemical approach followed by a hydrothermal treatment. Initially, carbon spheres were produced through hydrothermal method by treating the glucose in an aqueous solution in an autoclave for 10 h at 180 °C. Then, carbon spheres along with various nitrates of Ni, Co, Fe, Ce and Dy were mixed in DI H_2O and stirred for 30 min. The pH was adjusted to 7 by NH_3 solution. The solution was subjected to ultrasound irradiation and then to hydrothermal treatment. Several characterization techniques were used such as XRD, SEM, TEM, UV-vis DRS, magnetization and microwave measurements.

Results and discussion: The formation of cubic spinel ferrite phase with no secondary phases was checked via XRD technique. Spherical nanosized grains of hollow carbon spheres of $Ni_{0.5}Co_{0.5}Fe_{2-2x}Ce_xDy_xO_4$ were observed through SEM and TEM analysis. The prepared products revealed high microwave absorbing properties.

Conclusions: New set of excellent microwave absorbing materials consisting of hollow carbon spheres of $Ni_{0.5}Co_{0.5}Fe_{2-2x}Ce_xDy_xO_4$ were successfully prepared.

Key-words: Magnetic nanoparticles; Hollow carbon sphere; Ultrasound irradiation; Hydrothermal; Microwave applications.

Key Messages: The development of new excellent microwave absorbing materials.

*Corresponding Author:
Yassine Slimani,
Department of Biophysics, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
ORCID ID: https://orcid.org/0000-0002-2579-1617,
Phone: 00966599658876; Email: yaslimani@iau.edu.sa

Graphical abstract

IRMC-SRP-2020-20
Synthesis and characterization of hallow carbon spheres of CeDy substituted NiCo spinel ferrites

Ahad Alshahrani[1,2], Yassine Slimani [1*], Abdulhadi Baykal [3]

[1]Department of Biophysics Research, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
[2]Department of Chemistry, College of Science, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
[3]Department of Nanomedicine Research, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.

Abstract

Background: Many attempts were done to produce microwave absorbing materials having better heat stability, large absorption band, great absorption rate, and low cost, etc. Among these materials, spinel ferrite showed outstanding electromagnetic properties like high chemical stability, mechanical hardness, low dielectric loss, and high electrical resistivity, etc. On the other hand, hollow sphere structures gained great interest due to their better stability, strong permeability, high specific surface area, good dispersion, etc.

Objectives: We aim to develop carbon microspheres as templates to produce hollow carbon microspheres of CeDy doped NiCo spinel ferrite for microwave absorbing applications.

Methods and Material: The experiment is based on two steps: firstly, carbon spheres were synthesized via hydrothermal method by treating aqueous solution of glucose in an autoclave for 10 h at 180 °C. Secondly, carbon spheres of $Ni_{0.5}Co_{0.5}Fe_{2-2x}Ce_xDy_xO_4$ (where x = 0.00 and 0.02) were prepared using sonochemical approach followed by a hydrothermal treatment. Samples were washed and dried to get the final powder products. Several characterization techniques were used such as XRD, SEM, TEM, UV-vis DRS, magnetization and microwave measurements.

Results and discussion: XRD patterns showed the formation cubic spinel ferrite without any impurities. TEM observations showed that hollow carbon spheres of CeDy substituted NiCo ferrites are spherical in shape with nanosized scale. High microwave absorbing properties were obtained in hollow carbon spheres of CeDy substituted NiCo ferrites.

Conclusions: Hollow carbon spheres of CeDy substituted NiCo ferrites were prepared for the first time with excellent microwave absorbing performances.
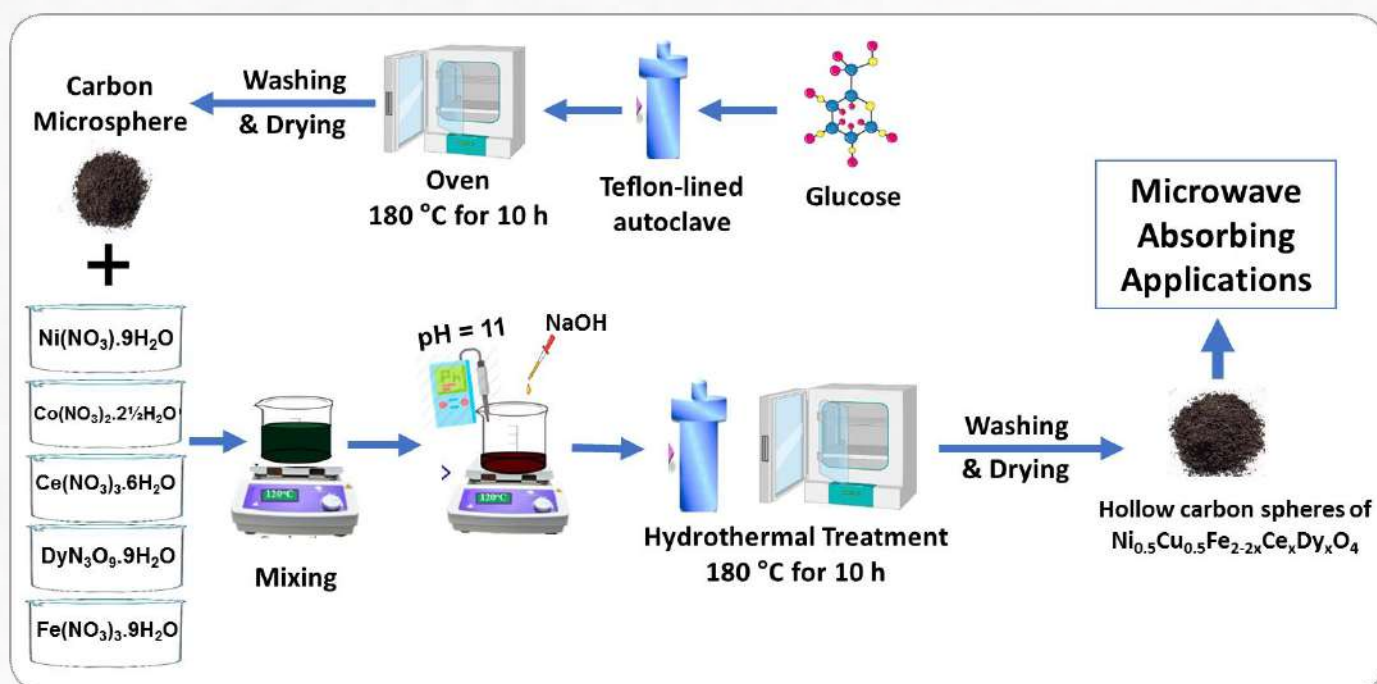
*Corresponding Author:
Yassine Slimani,
Department of Biophysics, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
ORCID ID: https://orcid.org/0000-0002-2579-1617,
Phone: 00966599658876; Email: yaslimani@iau.edu.sa

Graphical abstract

IRMC-SRP-2020-21

Effect of SiO$_2$ nanowires on Ferroelectric Barium Titanate Materials for Multilayer Ceramic Capacitors

Latifa Fahd AlOusi [1,2], Yassine Slimani [1*], Abdulhadi Baykal [3]

[1]Department of Biophysics Research, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
[2]Department of Chemistry, College of Science, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
[3]Department of Nanomedicine Research, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.

Abstract

Background: Barium titanate (BaTiO$_3$ or BTO) materials are widely used as dielectric medium for multilayer ceramic capacitors (MLCC) due to its excellent electrical properties, low dielectric loss, and high dielectric constant. Although BTO systems possess promising dielectric properties, they suffer from the subsequent drawbacks: maximum magnitude of dielectric constant is achieved close to Curie temperature (T_c) that is distant from the ambient temperature. Voluminous attempts have been done to surmount the limitations of BTO systems. Additives or dopants could considerably alter the microstructure, affect the dielectric properties, and vary the operational temperatures of modified BTO systems.

Objectives: The goal is to enhance the dielectric properties of BaTiO$_3$ by doping it with SiO$_2$ nanowires for multilayer ceramic capacitor applications.

Methods and Material: Samples of BaTiO$_3$+xSiO$_2$ ceramics, where $x \leq 0.2$ wt% were produced through the solid-state reaction route. A planetary "Retsch - Ball Mill PM 200" was employed. Firstly, oxide powders of BaCO$_3$ and TiO$_2$ along with ethanol were mixed and grinded using HEBM (high energy ball milling) technique. The obtained powders were washed, dried, and then calcined in a high temperature furnace. Afterwards, different concentrations of SiO$_2$ nanowires were added, mixed, then compacted into the form of discs by means of PVA, and finally sintered for 6 h at 1250 °C. The obtained ceramics were examined via XRD, TEM, SEM, UV-Vis DRS, and FT-IR techniques. The dielectric properties were also studied.

Results and discussion: XRD patterns revealed the successful formation of the desired ferroelectric BaTiO$_3$+xSiO$_2$ ceramics. SEM observations showed spherical-shaped grains for all samples. The band gap energies (E_g) were also estimated for all ceramics. It was found that the dielectric and optical properties are strongly dependant on the microstructure development of synthesized ceramics. The current products could be promising for multilayer ceramic capacitor applications.

Conclusions: Ceramics of BaTiO$_3$+xSiO$_2$ nanowires ($x = 0 - 0.2$) were successfully prepared. The enhanced dielectric and optical properties could make these ceramics as prospective applicants for multilayer ceramic capacitor.

Key-words: Barium titanate; SiO$_2$ nanowires; Multilayer ceramic capacitors; Curie temperature; Microstructure, Optical properties; Dielectric properties.

Key Messages: Enhance the dielectric properties of BaTiO$_3$ for multilayer ceramic capacitor applications.
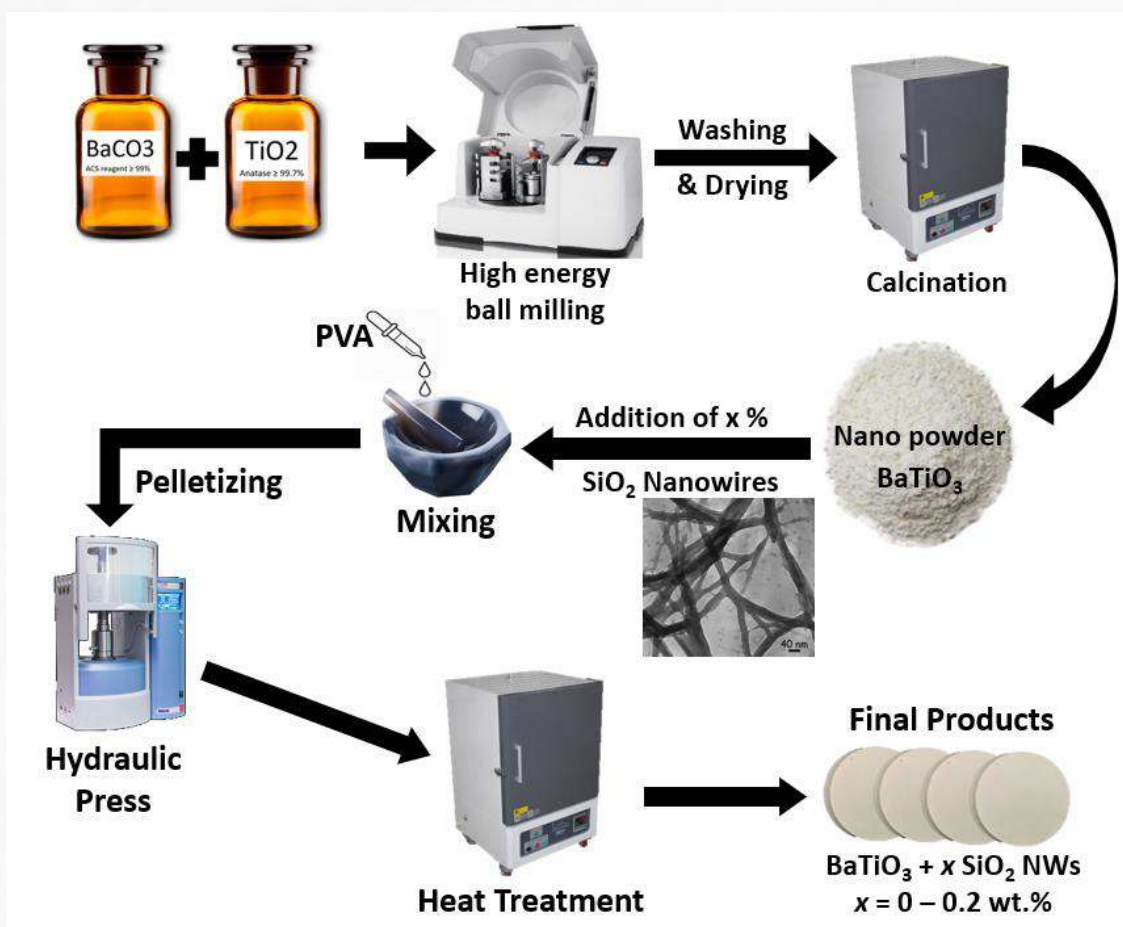
*Corresponding Author:
Yassine Slimani,
Department of Biophysics, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
ORCID ID: https://orcid.org/0000-0002-2579-1617,
Phone: 00966599658876 ; Email: yaslimani@iau.edu.sa

Graphical abstract

IRMC-SRP-2020-22

Effects and Investigation of Titanium Oxide Nanowires Addition on High-Tc Superconductor YBCO Performances

Ahmed Taha Okasha [1,2], Yassine Slimani [1*], Abdulhadi Baykal [3]

[1]Department of Biophysics Research, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
[2]Department of Mechanical and Energy Engineering, College of Engineering, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
[3]Department of Nanomedicine Research, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.

Abstract

Background: Superconducting materials are one of great interest in allowing the energy to flow efficiently through them without generating unwanted heat and therefore without any loss of energy. $YBa_2Cu_3O_y$ (noted YBCO) is one of the most promising superconductors for several technological applications. However, the weak flux pinning of YBCO material limits its use in superconducting-based technological applications. Much efforts have been made to improve the superconducting parameters of YBCO material, particularly superconducting critical transition temperature (T_{co}), critical current density (J_c) and activation energy (E_a).

Objectives: The present study aims to introduce efficient artificial pinning centers within the YBCO material that inhibit the motion of vortices and hence improve its superconducting parameters.

Methods and Material: Products of $YBa_2Cu_3O_y$ + x TiO_2 with x = 0 - 1 wt.% were prepared using solid-state reaction. Firstly, precursor of YBCO was formed by mixing powders of Y_2O_3, $BaCO_3$ and CuO. The mixture was subjected to calcination step. Once the precursor is obtained, different concentration of TiO_2 nanowires were added, pelletized and then heat treated in high-temperature furnace. The structure, morphology, optical and superconducting properties of various samples were characterized using XRD, SEM, UV-vis DRS and AC susceptibility techniques.

Results and discussion: XRD analysis showed the orthorhombic structure of all $YBCO/TiO_2$ sintered samples. SEM showed the dispersion of TiO_2 nanowires between YBCO grains. The optical band gap energies for all samples were estimated and influenced by TiO_2 additions. Using the AC susceptibility measurements, the activation energy (E_a) was deduced and found to be enhanced with small amount of TiO_2 nanowires.

Conclusions: The obtained results indicated that the addition of TiO_2 nanowires within YBCO material could be effective route to improve the superconducting properties.

Key-words: YBCO superconductor; TiO_2 nanowires; Optical properties; AC susceptibility; Activation energy.

Key Messages: Improve the superconducting properties of $YBa_2Cu_3O_y$ high-temperature superconductor.

*Corresponding Author:
Yassine Slimani,
Department of Biophysics, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
ORCID ID: https://orcid.org/0000-0002-2579-1617,
Phone: 00966599658876; Email: yaslimani@iau.edu.sa

Graphical abstract

IRMC-SRP-2020-23
Color blindness diagnosis using fNIRS

Mai Mansour AlMansour [1], Fatima Fahad Janahi [2], Murad Mohsen Althobaiti [3*]

[1,2]Department of Genetic Research, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
[3]College of Engineering, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.

Abstract

Background: Color blindness can be described as a disease that can happen due to eyes or brain damages, or it can be passed genetically from the parents. The disease used to be diagnosed by two old ways, the Ishihara test, and the color arrangement method other than diagnosing it with brain-imaging devices. One of the most effective brain-imaging devices is the functional near-infrared spectroscopy (fNIRS) or Optical Topography, It is a non-invasive brain-imaging device that helps to assess cerebral activity by detecting the changes of oxygenated and deoxygenated hemoglobin concentration in the blood.

Objectives: The purpose of this study is to identify the active areas of the visual cortex when stimulating different colors in front of normal people and for color-blind patients.

Methods and Material: A case-control study will be done on 44 cases and 44 controls, aged between (4-25 years old) living in Dammam, Saudi Arabia. By using a complete questionnaire to get the required information. Starting by exposing each sample to a single color and spotting the areas for each signal. Setting up and connecting the device to a screen to read and record the signals.

Expected Results: Each area of the visual cortex shows activity on different sides when stimulating different colors on the screen. Normal people in the brain revitalization processes differ from the color-blind patient. The absence of the signals in a specific area indicates that the person does not see this color and can be diagnosed with this disease. Using fNIRS on children under 7 years It will enable us to easily diagnose them with this color blindness. The results will be analyzed and discussed statistically.

Conclusions and discussion: The ability of fNIRS to diagnose color blindness will be applicable and capable successfully of detecting signals in different regions of the brain. fNIRS will help in diagnosing children under 7 years easily because of the distinctive characteristics of it.

Key Messages: The blood circulation can change in different areas of the brain depending on the region that was activated. Each color seen activates a different region in the brain than the other colors.
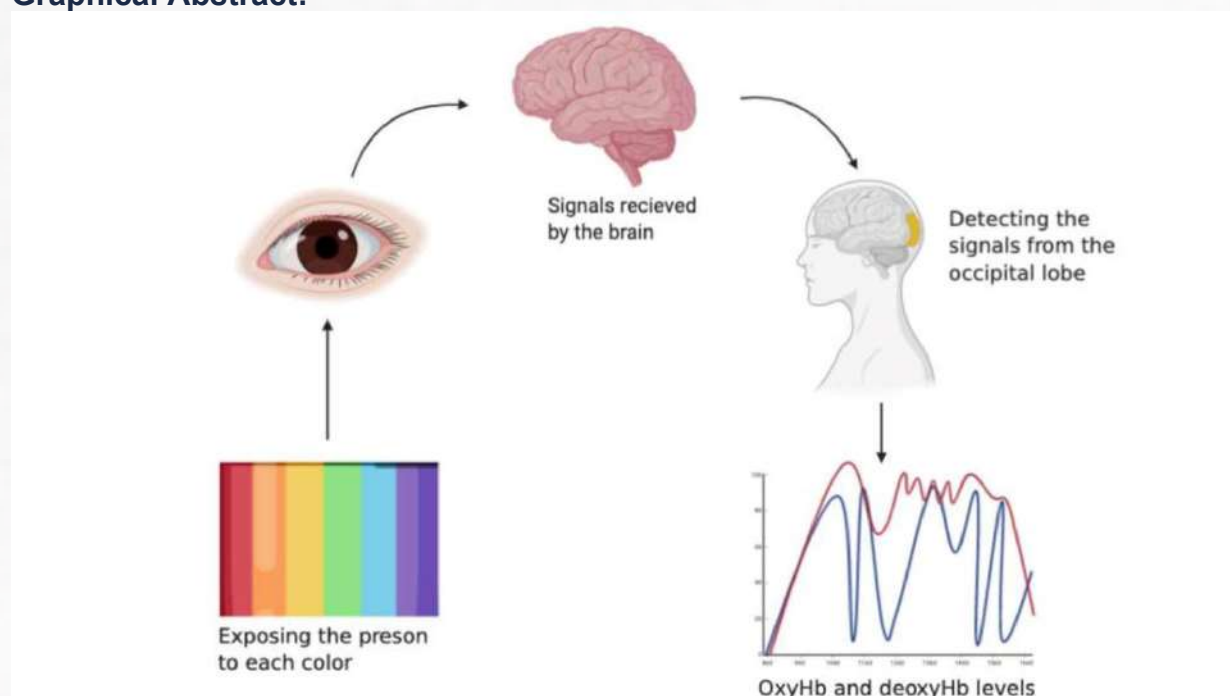
*Corresponding Author:
Dr. Murad Mohsen Althobaiti,
Department of Biomedical Engineering , Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
ORCID ID: https://orcid.org/0000-0002-8084-6916 ,
Phone: Ext (31693) Email: mmalthobaiti@iau.edu.sa

Graphical Abstract:

IRMC-SRP-2020-24
Color blindness diagnosis by using FNIRS

Fatima Fahad Janahi[1], Mai Mansour ALMansour [2], Dr. Murad Mohsen Althobaiti [1*]

[1]Department of Genetic Research, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
[2]College of Engineering, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.

Abstract

Background: Color blindness is an x-linked disorder that can be inherited from the parents or it can be acquired due to several diseases or even due to damages in the brain. The functional near-infrared spectroscopy (fNIRS) is a portable and non-invasive brain-imaging device that helps to assess cerebral activity by quantifying the hemodynamics of the brain.

Objectives: The purpose of this study is to identify the activated regions in the visual cortex when stimulating various colors in front of normal people and in front of patients with color blindness.

Methods and Material: A case-control study will be done on 88 participants (44 cases and 44 controls), age between 4 to 20 years old from the community living in Dammam, Saudi Arabia. A complete and specific questionnaire will be used to get the required information. Each sample will be exposed to a single color and the signals of the visual cortex will be monitored after setting up the fNIRS and connecting it to a screen to get the final results.

Expected results: We are expecting that for a normal person each region in the visual cortex will show activity in different side when stimulating various colors on the screen. According to the type of the disease, people with color blindness will show weak or no activity in a specific region of the visual cortex when they are subjected to the colors stimulation screen. By using fNIRS, children under 7 years old will be able to be diagnosed with color blindness unlike when using the usual Ishihara test. The results will be statistically analyzed and discussed after having the full data.

Conclusions and discussion: According to our expected results and due to the fNIRS distinguishing characteristics, the fNIRS application to diagnose color blindness in all ages -including children- will be successfully applicable and capable of detecting signals throughout different regions of the visual cortex.

Key-words: Color blindness, brain, disease, Optical Topography, brain-imaging, The functional near-infrared spectroscopy (fNIRS).

Key Messages: The hemodynamic ratio in various regions of the visual cortex in the brain can be changed according to the region that has been activated. Observing different colors can activate different regions of the brain.
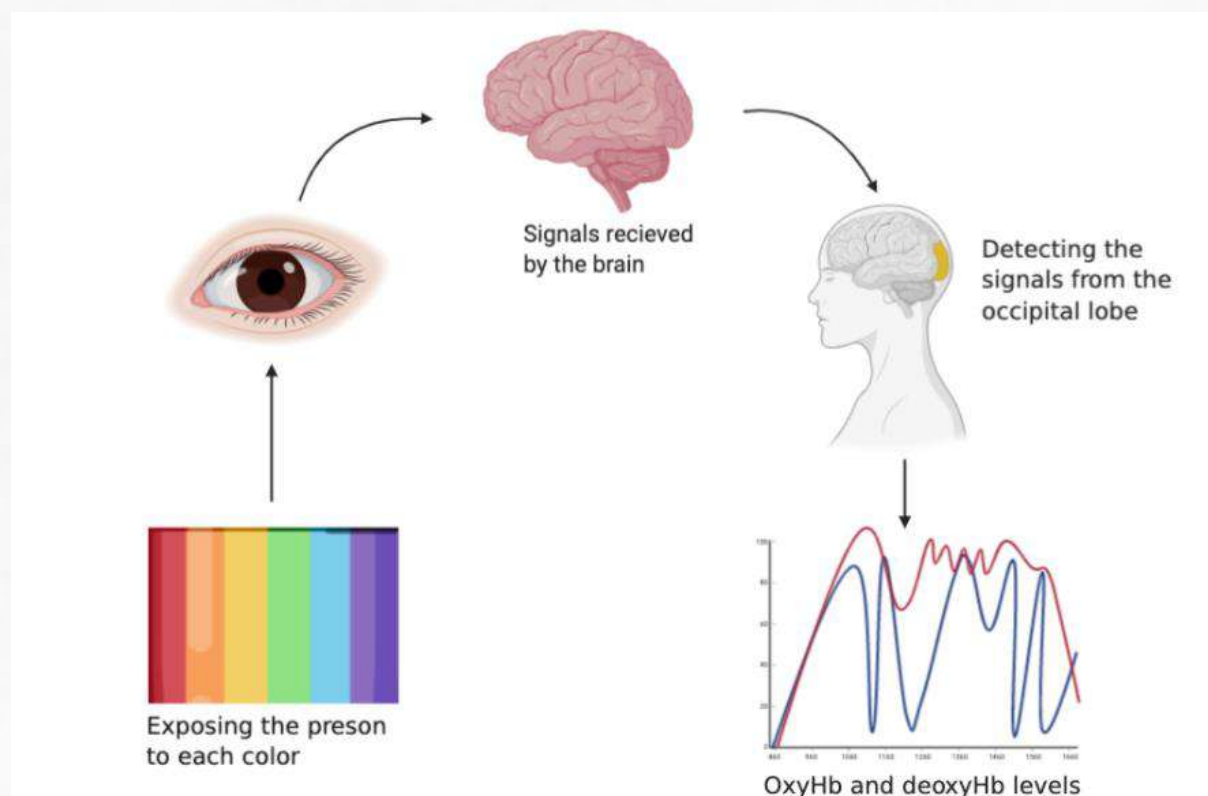
*Corresponding Author:
Dr. Murad Mohsen ALthobaiti

Department of Biomedical Engineering Department, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
ORCID ID: https://orcid.org/0000-0002-8084-6916,
Phone: Ext (31693) Email: mmalthobaiti@iau.edu.sa

Graphical abstract

Signals recieved by the brain

Detecting the signals from the occipital lobe

Exposing the preson to each color

OxyHb and deoxyHb levels

IRMC-SRP-2020-25

Preparation and Dielectric Properties of Graphene Nanoplatelets-Doped BaTiO$_3$ Nanocomposites for Electromagnetic Interferences (EM)

Gaeet AlFalah [1,2], Yassine Slimani [1*], Abdulhadi Baykal [3]

[1]Department of Biophysics Research, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
[2]Department of Mechanical and Energy Engineering, College of Engineering, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
[3]Department of Nanomedicine Research, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.

Abstract

Background: The electromagnetic (EM) emissions from a comprehensive variety of electronic circuits may degrade to effectiveness of other devices or may adversely affect human health. To resolve these complications, numerous researches have been done on electromagnetic wave absorbers. Barium titanate (BaTiO$_3$) is found to be typical one with the characteristic of microwave absorption, due to its specific properties. Nevertheless, there are certain characteristic flaws (e.g. unsatisfactory value of reflection loss and limited absorption band width) that prevent pure barium titanate from operating as electromagnetic wave absorbers.

Objectives: This study aims to synthesize BaTiO$_3$ doped with Graphene nanoplatelets in order to enhance the dielectric and microwave absorbing properties.

Methods and Material: Series of BaTiO$_3$ doped with different content of Graphene nanoplatelets samples were prepared by solid state reaction approach. Polyvinyl alcohol (PVA) was used as binder to get densified disks during compacting. The disks were subjected to heat treatment at 1200 °C for 5 h. The produced products were analyzed by XRD, SEM, optical, and dielectric measurements.

Results and discussion: XRD patterns of the BaTiO$_3$/Graphene composites showed that various products are consistent with the pure phase of BaTiO$_3$ (tetragonal structure) with no diffraction peaks other than those from BaTiO$_3$/Graphene are identified in these products, revealing the high purity of produced nanocomposites. The optical as well as the dielectric properties were investigated and correlated with microstructure changes. The composite with dense microstructure revealed good dielectric traits. This composite is supposed to have potential applications in EM wave absorbers.

Conclusions: Composite of BaTiO$_3$/Graphene were well prepared using solid state reaction. The composite with better dielectric traits is assumed to have potential applications in EM wave absorbers.
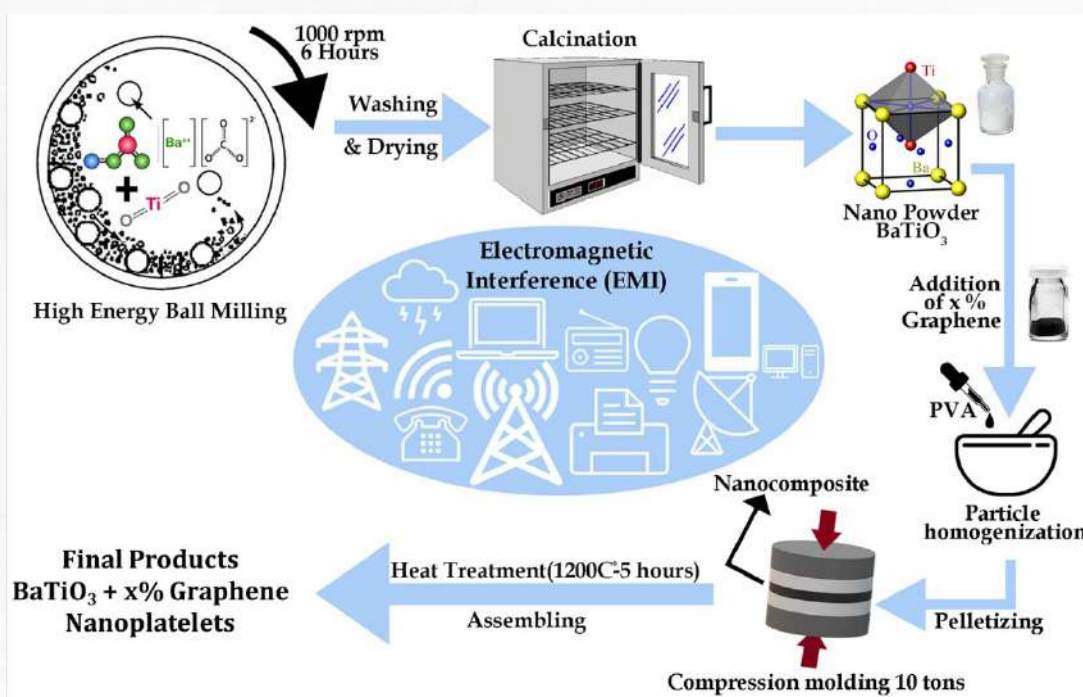
*Corresponding Author:
Yassine Slimani,
Department of Biophysics, Institute for Research and Medical Consultations (IRMC),
Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
ORCID ID: https://orcid.org/0000-0002-2579-1617,
Phone: 00966599658876 ; Email: yaslimani@iau.edu.sa

Graphical abstract

Improved Critical Current Density in YBCO added carbon nanotubes Superconductor

Rahaf Braek Alshamrani [1,2], Yassine Slimani [1*], Abdulhadi Baykal [3]

[1]Department of Biophysics Research, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
[2]Department of Chemistry, College of Science, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
[3]Department of Nanomedicine Research, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.

Abstract

Background: YBCO is one of the famous high temperature superconductors that is very important for various technological applications. However, this type of superconductor suffers from weak critical density in the presence of an external magnetic field. This problem can be resolved by addition of artificial nano-sized entities inside YBCO superconductor. Recently, Carbon nanotubes (CNTs) have attracted the attention of researchers due to their excellent structural and functional characteristics such as high mechanical strength and high electrical properties.

Objectives: Our objective in this work is to enhance the value of critical density of YBCO material under external magnetic field and hence improve its performance for practical applications.

Methods and Material: The synthesis of YBCO+CNTs samples is achieved by using solid state route and following two steps of sintering. Firstly, powders of Y_2O_3, $BaCO_3$ and CuO were stoichiometrically mixed, pelletized and then calcined at 950 °C to form precursor of YBCO. After that, different amounts of carbon nanotubes were added to precursor of YBCO. Both powders were mixed, compacted and subjected to the second sintering step at 950 °C. The final samples were then characterized using XRD, SEM and VSM techniques. The electrical resistivity measurements were also performed to evaluate the superconducting properties of the samples.

Results and discussion: XRD analysis showed the formation of single YBCO phase with orthorhombic structure for all samples. SEM observations revealed the dispersion of CNTs inside YBCO grains with the presence of crystal defects. The electrical measurement confirmed that all samples exhibit a superconducting transition. The critical current density versus magnetic field J_c (H) is determined by using VSM technique. The results analysis indicated an enhancement of J_c (H) with CNTs inclusion.

Conclusions: Samples of YBCO superconductor with different amounts of CNTs addition were successfully synthetized. All results proved the relevant effect of CNTs addition on the YBCO performance.

Key-words: YBCO superconductor; Carbon nanotubes; Solid state reaction; Electrical resistivity; Critical current density.

Key Messages: Enhance the critical density of YBCO superconducting materials under external magnetic field by carbon nanotubes addition.
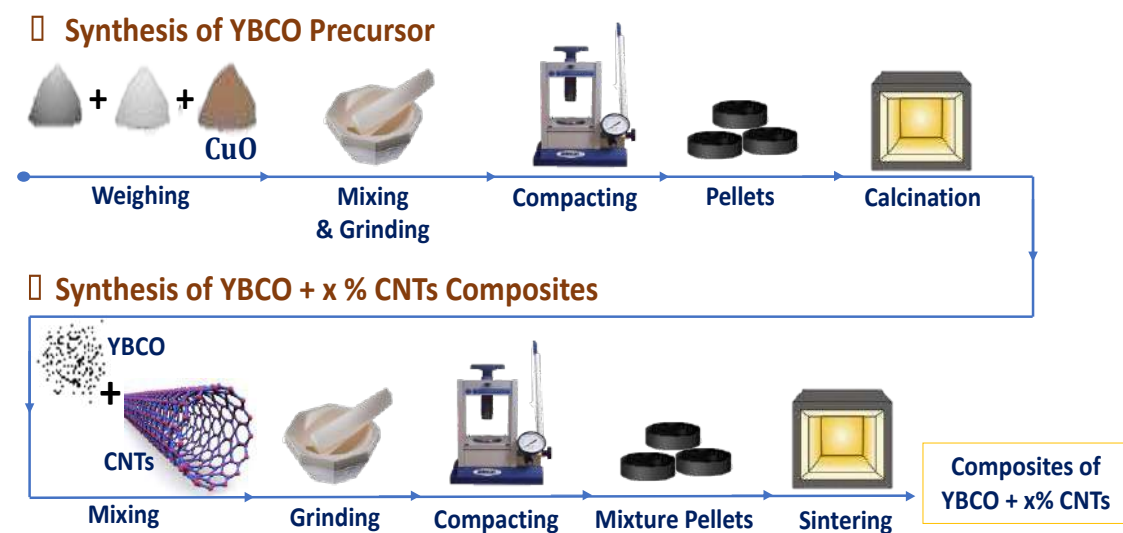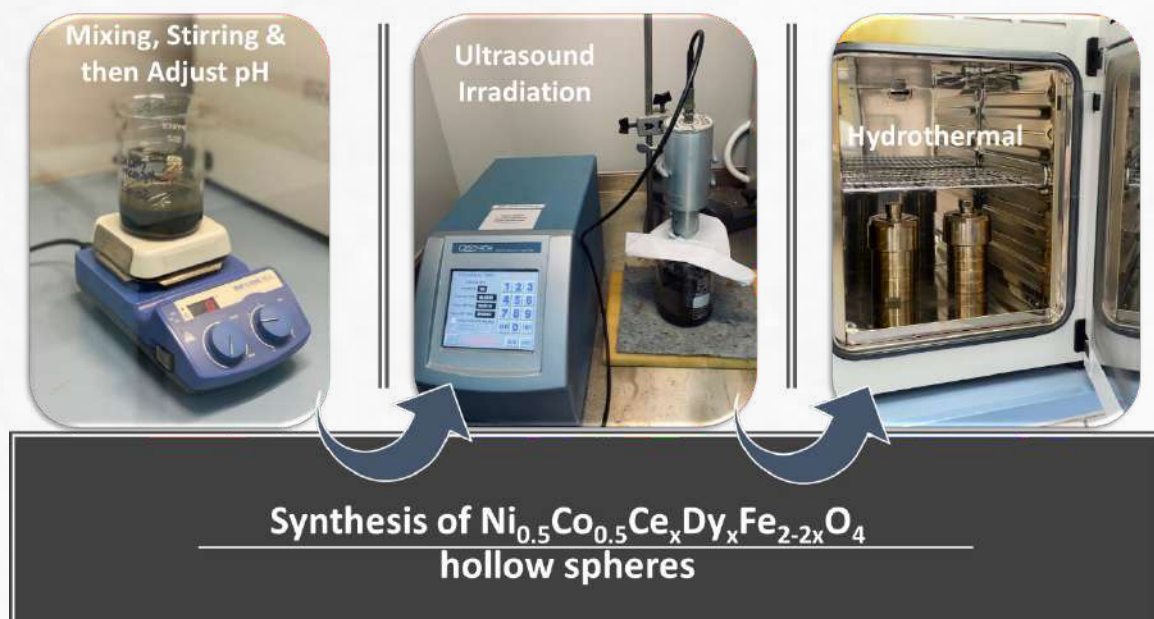
*Corresponding Author:
Yassine Slimani,
Department of Biophysics, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
ORCID ID: https://orcid.org/0000-0002-2579-1617,
Phone: 00966599658876; Email: yaslimani@iau.edu.sa

Graphical abstract

IRMC-SRP-2020-27

Synthesis and Investigation of CeDy doped NiCo ferrites Hallow Spheres with enhanced microwave absorbing performances

Wejdan Alhajri [1,2], Yassine Slimani [1*], Abdulhadi Baykal [3]

[1]Department of Biophysics Research, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
[2]Department of Chemistry, College of Science, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
[3]Department of Nanomedicine Research, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.

Abstract

Background: Magnetic spinel ferrite nanoparticles raised the enthusiasm owing to their capability to be used as microwave absorbers, gas sensors, catalysis, photocatalysts, etc. Many attempts were performed in order to synthesize new promising microwave absorbing materials with enhanced performances. The combination of magnetic spinel ferrite nanoparticles and electrically conductive hollow carbon spheres could lead to excellent microwave absorbing properties.

Objectives: The objective is to design magnetic nanoparticles $Ni_{0.5}Co_{0.5}Ce_xDy_xFe_{2-2x}O_4$ (x = 0.08 - 0.10) hollow spheres and enhance their magnetic and microwave properties.

Methods and Material: $Ni_{0.5}Co_{0.5}Fe_{2-2x}Ce_xDy_xO_4$ (where x = 0.08 and 0.10) hallow spheres were produced via sonochemical approach followed by a hydrothermal treatment. For that reason, aqueous solution of glucose was subjected to hydrothermal treatment for 10 h at 180 °C to produce carbon spheres. The obtained carbon spheres were mixed with various nitrates of Ni, Co, Fe, Ce and Dy in DI H_2O and stirred for 30 min. Then, the pH = 7 was adjusted by adding some drops of ammonia solution. The solution was subjected to ultrasound irradiation and then to hydrothermal treatment. Afterward, the solution was filtered and dried to get final powder product. Products were characterized by means of XRD, SEM, TEM, UV-vis DRS, magnetization and microwave measurements.

Results and discussion: According to XRD analysis, $Ni_{0.5}Co_{0.5}Fe_{2-2x}Ce_xDy_xO_4$ (where x = 0.08 and 0.10) hallow spheres with no secondary phases were successfully formed. The final products displayed spherical grains at nanosize scale as revealed by SEM and TEM observations. The microwave absorbing properties of samples were examined, and an enhancement was achieved.

Conclusions: $Ni_{0.5}Co_{0.5}Fe_{2-2x}Ce_xDy_xO_4$ (where x = 0.08 and 0.10) hallow spheres showed enhanced microwave absorbing properties.

Key-words: Spinel ferrites; Ultrasound irradiation; Hydrothermal; Magnetic properties; Microwave applications.

Key Messages: Enhance the microwave absorbing properties of magnetic nanomaterials.
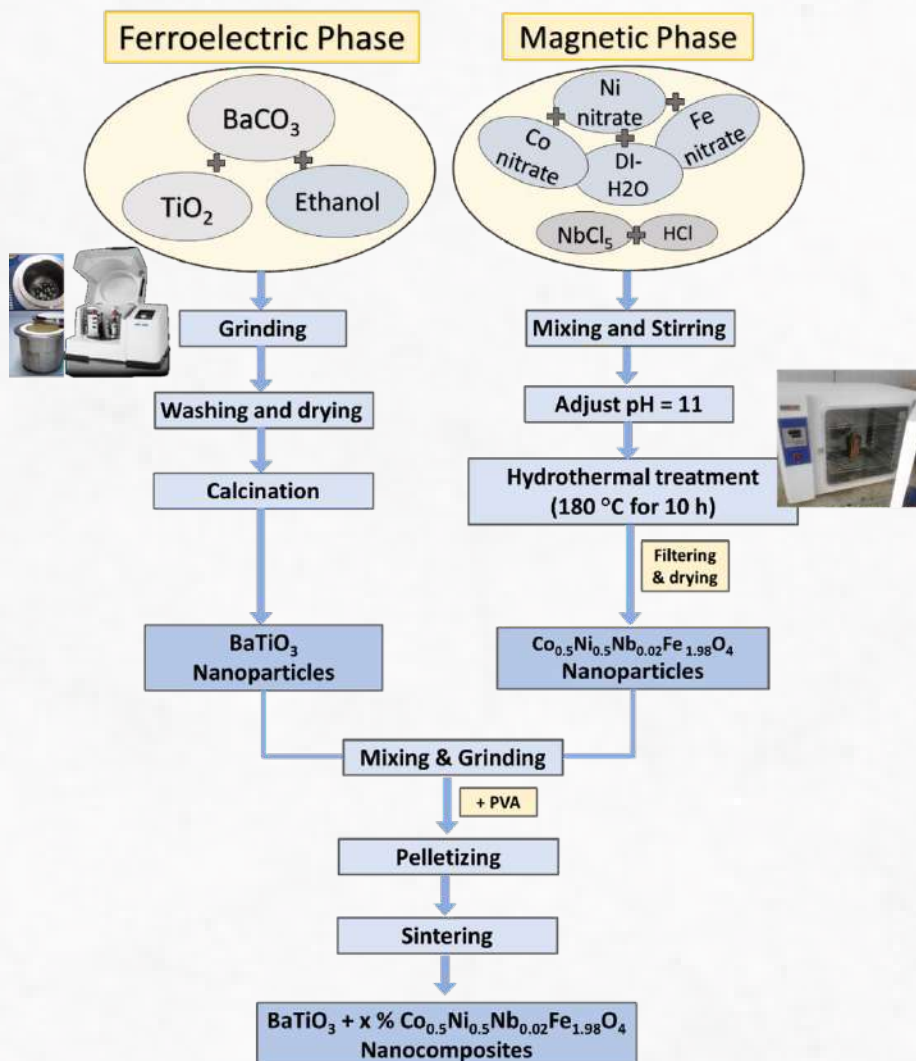
*Corresponding Author:
Yassine Slimani,
Department of Biophysics, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
ORCID ID: https://orcid.org/0000-0002-2579-1617,
Phone: 00966599658876; Email: yaslimani@iau.edu.sa

Graphical abstract

IRMC-SRP-2020-28

Effect of Nb doped CoNi ferrites on the structural, optical, magnetic and dielectric properties of BaTiO$_3$ materials

Moustafa M. Aouna[1,2], Yassine Slimani [1*], Abdulhadi Baykal [3]

[1]Department of Biophysics Research, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
[2]Department of Civil Engineering, College of Engineering, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
[3]Department of Nanomedicine Research, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.

Abstract

Background: Barium titanate (BaTiO$_3$) is one of the most widely used ferroelectric materials because of its particular characteristics. Recently, the introduction of magnetic nanomaterials in the nonmagnetic perovskite BaTiO$_3$ material has attracted the researchers to add the functionality of magnetism within the host crystal that develop their utilization in multi-functional electronic devices. The search of an efficient approach to produce ferroelectric-magnetic composites is a crucial aim of several researchers.

Objectives: We purpose to synthesize ferroelectric-magnetic composites that display enhanced performances to be utilized in numerous electronic devices.

Methods and Material: Ferroelectric-magnetic composites of BaTiO$_3$ + x % Co$_{0.5}$Ni$_{0.5}$Nb$_{0.02}$Fe$_{1.98}$O$_4$ were prepared via solid state reaction. Magnetic nanoparticles of Nb substituted CoNi ferrites were synthesized by hydrothermal method. On the other hand, ferroelectric BaTiO$_3$ nanopowders were prepared via solid state reaction through the use of high energy ball milling machine. Afterward, the two phases were mixed in an agate mortar, compacted into the form of disks by the help of polyvinyl alcohol (PVA) and then subjected to heat treatment at high temperature. The structure, microstructure, optical, magnetic and dielectric properties were investigated by XRD, SEM, TEM, UV-vis DRS, VSM and Impedance analyzer techniques, respectively.

Results and discussion: XRD, SEM and TEM results revealed the presence of the ferroelectric BaTiO$_3$ and the magnetic Co$_{0.5}$Ni$_{0.5}$Nb$_{0.02}$Fe$_{1.98}$O$_4$ phases within the prepared nanocomposites. The optical, magnetic and dielectric properties are governed by structure and microstructure of BaTiO$_3$ + x % Co$_{0.5}$Ni$_{0.5}$Nb$_{0.02}$Fe$_{1.98}$O$_4$ nanocomposites. The introduction of suitable magnetic phase into BaTiO$_3$ could enhance and develop new generation of multifunctional electronic devices.

Conclusions: The introduction of suitable amount of magnetic $Co_{0.5}Ni_{0.5}Nb_{0.02}Fe_{1.98}O_4$ phase into the ferroelectric $BaTiO_3$ could enhance and develop their utilization in multifunctional electronic devices.

Key-words: Barium Titanate; Spinel ferrite nanoparticles; Composites; Microstructure; Dielectric properties.

Key Messages: Development of new ferroelectric-magnetic nanocomposites with enhanced properties.
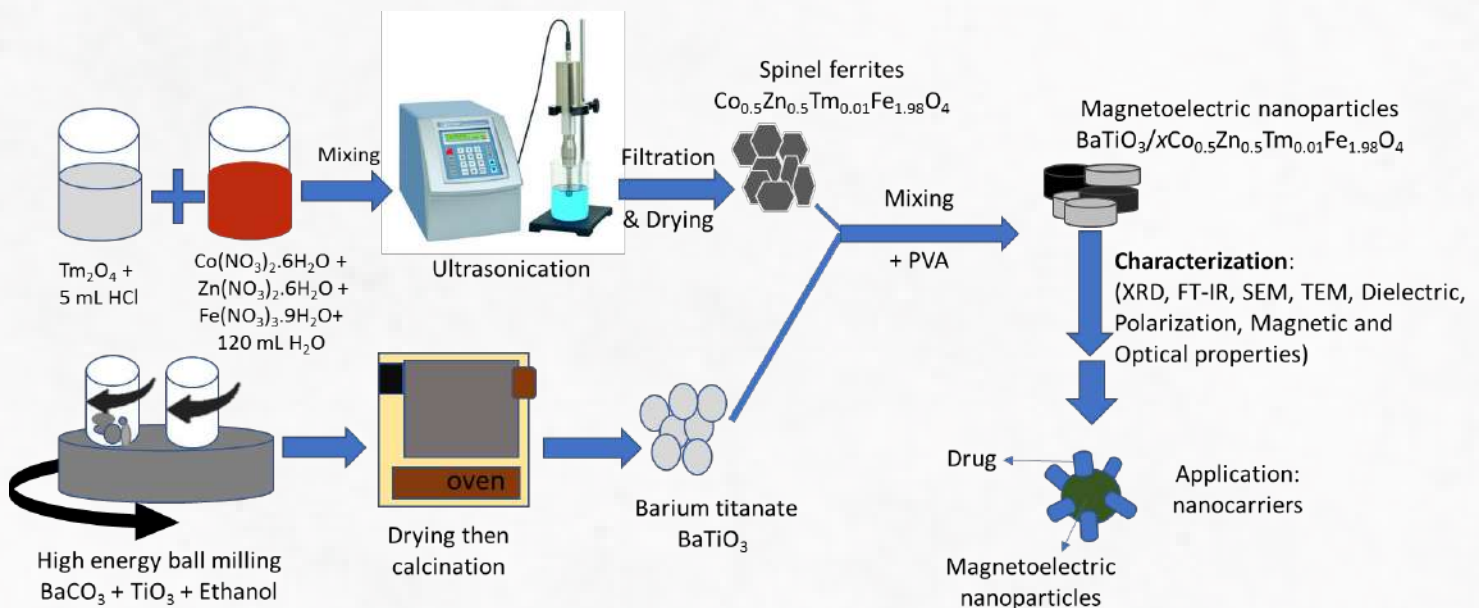
*Corresponding Author:
Yassine Slimani,
Department of Biophysics, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
ORCID ID: https://orcid.org/0000-0002-2579-1617,
Phone: 00966599658876; Email: yaslimani@iau.edu.sa

Graphical abstract

Design of enhanced magnetoelectric nanocomposites BaTiO$_3$/xCo$_{0.5}$Zn$_{0.5}$Tm$_{0.01}$Fe$_{1.98}$O$_4$ for high-specificity anticancer drug delivery

Areej Hadi Al-mebti [1,2], Yassine Slimani [1*], Abdulhadi Baykal [3]

[1]Department of Biophysics Research, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
[2]Department of Chemistry, College of Science, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
[3]Department of Nanomedicine Research, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.

Abstract

Background: The ability to use nanoparticles as drug delivery considered one of the most appreciated application of nanomedicine. Traditional chemotherapy is not only affecting cancerous cells but also normal cells which leads to a dangerous side effect. That challenge can be overcoming by using more specified controlled form of nanomaterials known as magnetoelectric nanocomposites that combine ferroelectric and magnetic effects.

Objectives: In this study, we aim to design promising magnetoelectric nanocomposites with enhanced structural, morphological, magnetic and dielectric properties that can be worked as nanocarriers for high-specificity drug delivery.

Methods and Material: Magnetoelectric nanocomposites consist of mixture of BaTiO$_3$/xCo$_{0.5}$Zn$_{0.5}$Tm$_{0.01}$Fe$_{1.98}$O$_4$. The sonochemical approach was used to prepare the nanosized spinel ferrite Co$_{0.5}$Zn$_{0.5}$Tm$_{0.01}$Fe$_{1.98}$O$_4$ phase while the solid-state method was used to prepare ferroelectric BaTiO$_3$ phase. The obtained nanocomposites were characterized by X-ray diffraction for the crystal structure examination and scanning and transmission electron microscopes (SEM and TEM) for the morphology and microstructure observations. The dielectric, polarization, magnetic and optical properties were also studied.

Results and discussion: XRD patterns showed the successful formation of the desired nanocomposites. SEM and TEM observations showed the co-existence of ferroelectric BaTiO$_3$ and Co$_{0.5}$Zn$_{0.5}$Tm$_{0.01}$Fe$_{1.98}$O$_4$ phases in the produced nanocomposites. The dielectric, magnetic and optical properties were strongly depended on the microstructure development of synthesized nanocomposites. The produced nanocomposites will be used as nanocarriers for high-specificity anticancer drug delivery.

Conclusions: BaTiO$_3$/xCo$_{0.5}$Zn$_{0.5}$Tm$_{0.01}$Fe$_{1.98}$O$_4$ magnetoelectric nanocomposites were prepared for the first time. These nanocomposites could be potential candidates for high specificity of drug delivery to cancer cells.

Key-words: Magnetoelectric nanocomposites; Structure; Dielectric properties; Magnetic properties; Targeted drug delivery; Anticancer.

Key Messages: Synthesis of enhanced magnetoelectric nanocomposites for possible applications as drug delivery to cancer cells with high specificity.

*Corresponding Author:
Yassine Slimani,
Department of Biophysics, Institute for Research and Medical Consultations (IRMC), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia.
ORCID ID: https://orcid.org/0000-0002-2579-1617,
Phone: 00966599658876; Email: yaslimani@iau.edu.sa

Graphical abstract

| Preliminary report of IRMC-SRP-2020 |

Name of IRMC program	IRMC-SRP-2020 (Institute for Research and Medical Consultations - Summer Research Program – 2020)
Brief description of the program	IRMC has been organising innovative and multidisciplinary research oriented training program for talented students from various universities for eight weeks to achieve the objectives of IAU vision to transfer the knowledge and serve the community, the goals and developmental endeavours of the Kingdom, "Knowledge-based Society and Economy".
Total number of students	33
Internal Students	28
External Students	5
Number of male students	6
Number of female students	27
Period of the IRMC-SRP-2020	1st June 2020 to 23rd July 2020 (8 weeks)
Total number of lectures delivered through Zoom	19 (2 hours each)
Number of lab demonstration delivered through Zoom	5 (Numbers varies depend on the mentor)
Number of professional lectures delivered through Zoom	10 (2 hours each)
Numbers of training delivered through Zoom	4 (2 hours each)

Numbers of invited specialized Lecture delivered through Zoom	5 (2 hours each)
Number of onsite major trainings	2
Number of onsite specific trainings	2 to 10 depends on the specific field
Total number of hours spent by the students at IRMC	Up to 50 hours
Total number of hours spent in the program	200 + hours

Coordinator, IRMC-SRP-2020
The Dean, IRMC

| Disclaimer |

| Acknowledgments |