BVCPK TechMag 2023-24

Innovations in Pharmaceutical Sciences

Bharati Vidyapeeth
College of Pharmacy, Kolhapur

Principal's Desk

In the first instance, I congratulate the team of Bharati Vidyapeeth College of Pharmacy, Kolhapur for their consistent efforts to bring out Technical Magazine 2022-23. I appreciate the efforts in capturing the prominent advancements and events in pharmaceutical field and compiling them into this magazine. The distinctiveness of this institute in research is very well portrayed in this magazine. It will surely offer a great platform for students to explore novel pharmaceutical technologies. I wish this issue to be insightful and memorable.

Dr. H. N. More
Principal
Bharati Vidyapeeth
College of Pharmacy, Kolhapur

My best wishes to the editorial board for their enthusiasm in this endeavor. The pharmacy program at every level imbibe knowledge and skills to students and exploration of advanced pharmaceutical technology will enhance holistic development and will build competency essential for successful professional career. Compliments to my teaching faculty for not only emphasizing on academics but also participating in several research activities that have significantly contributed overall progress of this institute. Surely, the magazine will be informative and resourceful. Once again, I congratulate team to complete this edition.

Dr. M. S. Bhatia
Vice-Principal
Bharati Vidyapeeth
College of Pharmacy, Kolhapur

Editor's Note

Hello Readers !!!

It gives me a great pleasure to share Technical Magazine as BVCPK TechMag. This magazine comprised of conventional informative scientific write ups Apart from covering conventional informative scientific write ups, the issue also features Mind Lab – a brain storming section, I encourage the readers to participate in it. I convey heartfelt thanks to all faculties for having put their thoughts and experiences into an engaging read. I would like to appreciate the efforts taken by **Miss. Sneha Rochlani** for active participation in completing this TechMag.

We would welcome any feedback and suggestions for further improvement in TechMag for quality hearing. Happy reading !!!

Sincerely,

Dr. Rakesh P. Dhavale

Editor-In-Chief

Acknowledgement

Team BVCPK TechMag is very much thankful to Bharati Vidyapeeth College of Pharmacy, Kolhapur and management for providing a wonderful platform to explore and utilize our knowledge and skills. We wish to thank our Hon'ble Secretary, **Dr. Vishwajeet Kadam Sir, Dr. Shivajirao Kadam Sir, Dr. H. M. Kadam Sir**, for their patronage and **Dr. H. N. More Sir** advising us on the importance of enhancing the visibility of workplace that stimulated us to come out with **BVCPK TechMag**. We also thank all our colleagues and students for supporting us in making this TechMag on its completion.

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THE ROLE OF NEP 2020 IN NEW ERA OF EDUCATION

Mr. Rohan R. Chavan
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The new National Education Policy (NEP) 2020 is undoubtedly a positive step, and as an organization that has long fought for children's education to be considered one of their fundamental rights, CRY is examining some of the key points from the NEP to determine what positive changes it would bring and what may require additional thought and discussion to produce the desired results.

The education policy is framed on the foundational pillars of **Access, Equity, Quality, Affordability and Accountability**. Further it also aims at the Sustainable Development to transform India into a vibrant knowledge society and global knowledge superpower by making the education more holistic, flexible, and multidisciplinary. Universalising access to education is an issue of fundamental right, i.e., is to provide equal opportunity to all the people for education, irrespective of one's caste, creed, community, social status, race, gender, physical ability etc. In this context India's Gross Enrolment Ration (GER) for higher education, as per the statistical records, is 26.3% as of 2018 which is below the global average of 27 per cent. However, the GER for senior secondary students is 58.2%, and for secondary students it is 79%, indicating that a significant portion of students are either unable to enroll in higher education or would rather not. Only 20% of the 30 million students enrolled in college programs graduate each year. Additionally, the National Employability Report 2019 estimate blatantly highlights the fact that less than 20% of Indian engineers are employable in any profession in the knowledge economy due to a lack of technical job skills. The paradox of unemployment and unemployability in a nation with one of the fastest expanding economies in the world seems to be at play here. Inequality has been rising sharply for the last three decades, which undoubtedly is one of the main stumps to the sustainable development of the country.

The issue of demographic dividend has also been discussed the education policy, but no plausible relationship could be established between the education and demographic dividend, in spite of the revelation that very soon an average age of Indian would be as low as 29 years of age. The point of concern is, if the young aren't properly educated, or do not receive proper vocational training, the much-talked demographic dividend may boomerang as an irrevocable impediment. The footprints of the present crisis in education points to the mind-set of the people grappled in orthodoxies of a conservative society. Choosing a stable life, fitting in the framework of basic needs has been prevailing for ages.

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However, as a result of globalization, the growth of the IT and ITES industries sparked a rush toward quantity over quality, which ultimately resulted in the development of low-quality institutions that only provide these courses. Numerous studies have been conducted to determine the causes of the educational system's poor performance, and all arrows lead to our students' lack of practical life skills.

The current policy calls for a complete overhaul of the Indian educational system from elementary school through college. The NEP-2020 initiative aims to hold educational institutions—from schools to universities—responsible for the quality of their instruction in terms of its content, mode of delivery, and anticipated learning results. The ability to apply newly gained knowledge is what defines a quality education. The principles of theoretical knowledge do not fit the real-world practical applications. However, it is never a good idea to disregard theoretical knowledge because it is intended for deeper understanding before being made accessible to solve practical difficulties. The new policy places a strong emphasis on flexible, multi-disciplinary, and holistic education from the very beginning of learning, in accordance with this. Multidisciplinary studies are meant to inspire students to create a plan that is best suited for a certain professional route.

The initiative aims to significantly restructure and consolidate higher education institutions. As a result, it is envisaged that some schools would provide programs with top-notch teaching and research. If the autonomous colleges are regarded as degree-granting institutions, they may, nonetheless, prioritize teaching. In keeping with these concepts, the new education policy includes rules that make it easier for the top 100 international universities to operate in India. This is an effort to shift the focus from the local to the global and to support the transnational education system. It will, of course, plot national institutions on global axes in an effort to contrast the slopes of Indian educational institutions with those of their counterparts abroad. The ranking of the institution and its perception are very important in the current environment, when jobs and education have become increasingly international and professionals are searching outside the borders of our nation for chances. The best universities in India are said to have reasonably good ratings for the teaching environment and industry income, but they fall short when it comes to the global outlook when compared to both regional and international competitors. Hopefully, the decision to allow foreign universities to establish operations in the nation will significantly reform and improve the quality of education, and sooner rather than later our institutions will also rise to the top of the world rankings, bringing the dream of making India a research destination closer to reality.

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Foreign campuses would also raise the bar for higher education by introducing new technologies, pedagogies, and information to the nation, inspiring Indian schools to advance even further. It is our duty as educators to ensure that the higher education system in India continues to promote economic development and innovation while giving more Indians a chance to flourish in the knowledge economy. Its emphasis on global citizenship education (GCED) and value-based education will assist develop pupils who are aware of international challenges including climate change, conflict, poverty, and hunger as well as issues of equality and sustainability. Additionally, it makes graduates from India more employable and produces morally upright individuals.

The fourth industrial revolution has begun throughout the world. As a term describing the current trend of automation and data exchange in manufacturing technologies, including cyber-physical systems, the Internet of things, cloud computing, artificial intelligence & robots, big data computing, and developing the smart factory, industry 4.0 has been established. The creation of Multidisciplinary Education and Research Universities (MERUs) with a range of different entry and departure provisions has given higher education institutions optimism in this fast-track era. Critical thinking, problem-solving, flexibility, and other 21st-century abilities will be necessary as a minimum to meet the demands of the fourth industrial revolution In fact, a culture of research orientation permeates a particular university system. These universities are also known to have pricey labs with cutting-edge equipment, a digital library, excellent computing infrastructure, a competitive PhD program with qualified researchers, and talented research faculty. A few institutions/universities among the top 100 NIRF ranked institutes could be assisted to grow to become global universities by taking one or two lead models from such western universities. First and foremost, those chosen institutes should be encouraged to hire talented, driven, and dedicated faculty. Additionally, based on their past performance, they may be given sizeable research funding to build cutting-edge core facilities. Second, the National Research Foundation (NRF) has to significantly expand its financing for Research & Development (R&D). Additionally, it could become necessary for such institutions to produce work of the highest caliber at all times. But a lot of it depends on how enthusiastic, involved, and competent teachers. The new National Education Policy (NEP 2020), which includes the National Credit Framework (NCrF), is poised to completely transform the Indian educational sector. By bridging the gap between school and employment, this program has the ability to address one of the weaknesses in our educational system. The NCrF hopes to accomplish this through empowering a generation of knowledgeable and adaptable students who are ready to take on the challenges of a constantly changing global economy.

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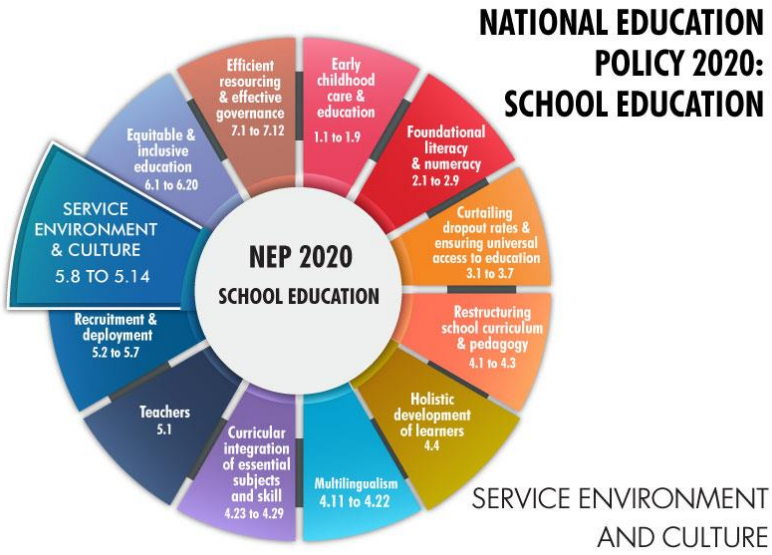

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NANOBOTS – A COMBINATION OF NANOTECHNOLOGY AND ROBOTICS

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Robotics and nanotechnology are ever-growing technologies affecting human lives more and more every day with advancements in fields such as life sciences and medicine. Nanobiotechnology adds a new dimension by combining robotics and nanotechnology with biology, creating nanorobotic systems, also known as 'nanobots'.

Nanobots are nanosized robotic systems that can perform specified tasks and are especially suitable for drug delivery. Typically, therapies pass through the whole body before reaching the target location. Nanobots help to improve the target accuracy of treatments, reducing the possibility of adverse side and off-target effects.

The most significant breakthrough of nanomedicine is nanobots. Nanobots can be employed to mend damaged cells and replace whole intracellular components. They can also be replicated to repair a genetic defect or replace a DNA molecule for disease eradication. Nanobots in medicine can provide profitable healthcare prospects, such as unblocking the arteries or replacing an organ altogether.

Although nanocarriers can provide exact dose concentrations to specific regions, their small size leads to a paradoxical compromise between volume and manufacture. Coordinated behaviour and communication via artificial intelligence will allow nanobots to fulfil their tasks methodically and efficiently. Nanobots might be individually programmed, searched, and circulated in distinct directions. Individual nanobot may connect with friends and co-workers, each with their distinct guidelines, to ask that they band their coatings, loads, or sizes together to monitor sick tissues existence, diagnosis, or targeting more efficiently.

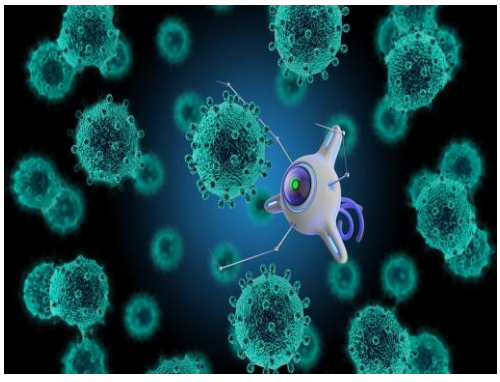

Fig. : Nanobots

Nanosized robots capable of accurately creating holes in specific cell membranes to destroy aberrant cells and even administering different medications are potential possibilities for

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AYURVEDIC PERSPECTIVE FOR COVID-19

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Because the entire globe is suffering from the COVID-19 epidemic, there has been a surge of attention in techniques to increase our immune power and therefore establish the first line of defense against the terrible virus. Therapeutic plants, shrubs, and medicines have been recognized for their therapeutic benefits from the classical era. As a result, therapeutic plants and herbs are playing an important role in decreasing the COVID-19 epidemic. It is also essential to eat nutrients in the form of formulations such as Tulsi, Amla, and Cumin, which will help your body fight infections. This study describes how common medicinal plants and herbs interact with COVID-19.

The COVID-19 outbreak has resulted in devastating effects on global populations due to the rapid outbreak. Most severely affected are old age persons, children, and patients with a clinical history of respiratory disorders, diabetes, cancer, weak immune system, and other diseases. Because of relatively large amount of death with this disease and the unavailability of drugs, the whole world is battling hard to discover an effective therapeutic treatment for COVID-19 [1]. Coronaviruses are the viral ones that cause respiratory diseases, but they can also impact the gastrointestinal system and attack both living creatures extensively. Coronavirus are single-stranded Virus that are extremely varied and were originally discovered in 1960. Coronavirus genotypes are mostly found in bats, although they can transmit to certain other forms of life [2]. In the current scenario of the non-existence of any established medicines, there may be potential antiviral herbals extracts, formulations, and immune booster herbal medicines that can be the potential remedy against viral infections. Although the pathogenesis of COVID-19 is still not clear, persons infected wih COVID-19exhibit non-specific symptoms ranging from no symptoms (asymptomatic) to severe pneumonia and death. However, frequent symptoms are observed like diarrhea, lung damage, normal or decreased leukocyte counts [3-4].

Because the entire globe is suffering from a COVID-19 epidemic, It is a high scope in ways to improve our resistance to infection and therefore establish the first line of defense against the deadly virus. Therapeutic herbs have been noted as its therapeutic benefits throughout earlier civilizations. Therefore, Therapeutic natural compounds are helping to improve human resistance against the COVID-19 virus A variety of therapeutically significant botanicals that can help in the fight over COVID-19,

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Melia azadirachta L. (Neem), *Scuttelariabaicalensis* (Baikal Skullcap), *Salviamiltiorrhiza* (Red), *Echinacea purpurea* (Purple coneflower), sage), *Cinnamomumverum* (Cinnamon) C, *Linumusitatissimum* L. (Flax Seed), *Phyllanthus emblica* L. (Amla), *Piper nigrum* L. (Black Pepper), *Cinchona officinalis* (Quinine), etc. It is also essential to take immunological and nutritional supplementation like vitamin A, B, iron, various minerals, which will help your body fight infections coronavirus or other illnesses such as hypertension, cardiovascular disease, or tumor. [5].

. Whenever the immunological system's response is insufficient, poor, or defective, it paves the way to illnesses like Many herbs shown the high in polyphenols, nutrients, enzymes, carbs, essential fats, lipids, ions, corticosteroids, antihistamines, antifungal, and antimicrobial phytonutrients, that contribute in the restoration as well as the eradication of pathogens**.**

The invaded viruses. Several Ayurvedic medicines are reported to have antiviral, antiplatelet, anti-inflammatory, anti-allergic, antifungal, hyperglycemic effects, and so on. This plant is high in flavonoids, tannins, steroids, glucoside quinones, sesquiterpenoid, and aromatic chemicals. Scientific researches on this drug may provide a new approach as well as insight for prevention, management, and development of new therapeutic entities to treat COVID-19. Mostly in present epidemic illness (COVID-19), most people with the severe infection are likely most sensitive to this virus and its severe consequences. Also, immune-enhancing herbs could be beneficial to the human body battle against COVID-19 diseases. Here we provide are view of some immune-boosting herbs and their important features with preclinical and clinical evidence of the antiviral actions. Many supplements basically from medicinal plants may help improve immune response [6].

Various medicinally important plants and herbs which can serve as a boon in the fight against COVID-19 e.g. Tulsi (*Ocimum sanctum*), clove (*Syzygiumaromaticum*), Black paper (*Piper nigrum*), , turmeric (*Curcuma domestica*), Giloy (*Tinosporacordifolia*), etc. Many herbs are good for the heart, vitamins, proteins, carbohydrates, dietary fibres, amino acids, minerals, steroids, alkaloids, antiviral, and antibacterial phytochemicals, which assist to rejuvenate the immune function and fight viruses. Many Ayurvedic medicines are known to have antioxidant, antiplatelet, anti-inflammatory, anti-allergic, antimicrobial, hyperglycemic effects, and so on. This plant is high in polyphenols, tannins, stimulants, sesquiterpene quinones, sesquiterpenoid, and heterocyclic chemicals. Scientific researches on this drug may provide a new approach as well as insight for prevention, management, and development of new therapeutic entities to treat COVID-19, it is apparent that people with a severe infection are most vulnerable to this virus and its severe consequences.

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In this regard, immune-enhancing herbs may be helpful for the body to fight COVID-19 infection. Here we provide are view of some immune-boosting herbs and their important features with preclinical and clinical evidence of the antiviral actions. Many supplements basically from medicinal plants may help improve immune response [7, 8].

Fig.: Probable Allopathic Medicines for Covid-19

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THE ROLE OF ARTIFICIAL INTELLIGENCE

Mr. Rohan R. Chavan
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The way academic and administrative staff use their time and the way that each student is treated uniquely can both be significantly impacted by the usage of AI in education. Organizations in the education industry are benefited by artificial intelligence applications on two different levels.

1. Administrative level (admission, counseling, library services, etc.)
2. Academic Level (assessment, feedback, tutoring, etc.)

Applications of AI have a significant impact on the systems and processes of education and learning. The truth is that artificial intelligence (AI) has fundamentally changed administrative and academic operations in a variety of ways, including the admissions process, offering counseling, library services, assessment, feedback, tutoring, etc. The importance of AI has made it a popular research topic in general and a developing field in education. Several algorithms were built in accordance with the aims since it has a strong link with both academic and administrative responsibilities. It can be used to obtain and offer assistance with many types of examinations, behavioral patterns, and many other factors. Teachers typically handle duties like curriculum development, course preparation, and student evaluation. Many of the duties carried out in educational institutions overlap; for instance, a teacher's primary responsibilities are teaching and administrative tasks like grading and evaluation. These are the factors that have an impact on a teacher's primary responsibility, which is teaching. Tasks that require the participation of both administrative and academic staff can take a lot of time and resources. The information on a student is necessary for many duties in any educational organization, which is the major cause of this. Some information is administrative-specific, whereas a teacher is the primary source for other information. The key challenges are the extra work that teachers must do, the usage of additional resources in various forms, and the caliber of the information needed to make final decisions. Big data approaches are utilized to provide teachers with information about their kids so they may make the best choice. Personalized Education (PE), Grading/Assessments (G/A), Learning Analytics (LA), and Admissions (A) are a few of the most significant changes that AI has brought about both within and outside of the classroom. It can be challenging to provide each student the attention they need, especially in institutions and nations with small resources and insufficient faculty, when students' talents and intellectual levels vary widely within a single classroom. The AI applications close this significant gap by offering specialized tutoring, among other things.

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Each student is able to learn in accordance with his or her mental capacity and talents thanks to the adaptive learning and personalized education capabilities of AI applications.

Teachers and tutors are responsible for a variety of duties outside of teaching, such as grading, assessment, evaluation, parent communication, creating lesson plans and outlines, and more. The teachers must devote considerable time and focus to each of the activities. However, these days, AI applications help and support teachers in carrying out those tasks, freeing them up to focus on other jobs that call for a personal touch, like allocating time to students who deserve it more, supervising projects, and engaging in academic discussions with students.

Numerous administrative chores are also a part of learning and education. Some of these duties include managing admission applications and processes, enrolling students in various courses or sessions, and selecting qualified and promising students. Education institutions must also deal with the analysis of employment applications and the hiring of human resources. Institutions are now using AI technologies to manage the aforementioned activities more easily.

The admissions procedure for any educational institution is being aided by AI technologies and software. The admissions department must receive an online application before the admissions process can begin. Along with this, the admission form is accompanied with frequent questions from applicants and their parents, which are challenging to respond to in a short amount of time.

Education organizations are utilizing AI solutions in the form of chatboxes, etc. to handle the influx of questions during the application process or admission period to address the issue.

Limitations:

1. The scope of this study is limited to the AIA discussed above, although there are many other applications of AI in the education sector like distance learning, tutoring, trial, and error elimination, Personalized Education, human resource management, etc., which will be covered the incoming part of the research. The study is not tested quantitatively to make it more generalized.
2. As the research discusses the impact or role of AI technology in education, it has a strong link with society. In this study, we have reviewed the positive aspects/roles of AI applications and not discussed its negative or ethical concerns in education or in society. The results of AI implementation may be different and may depend on case to case and society to society in the shape of positive and negative roles. The same phenomenon is common for another scientific research.

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Future Work: -

1. There are many other applications of AI in the education sector like distance learning, tutoring, trial, and error elimination, Personalized Education, human resource management, etc., which can be researched in the future.
2. Testing the study quantitatively to make it more generalized.
3. A systematic review of AIA can be conducted to make the area more explored.
4. Ethical concerns of AI in education were also not of this study scope. Future work can be done on the issues which may arise from AI in education.

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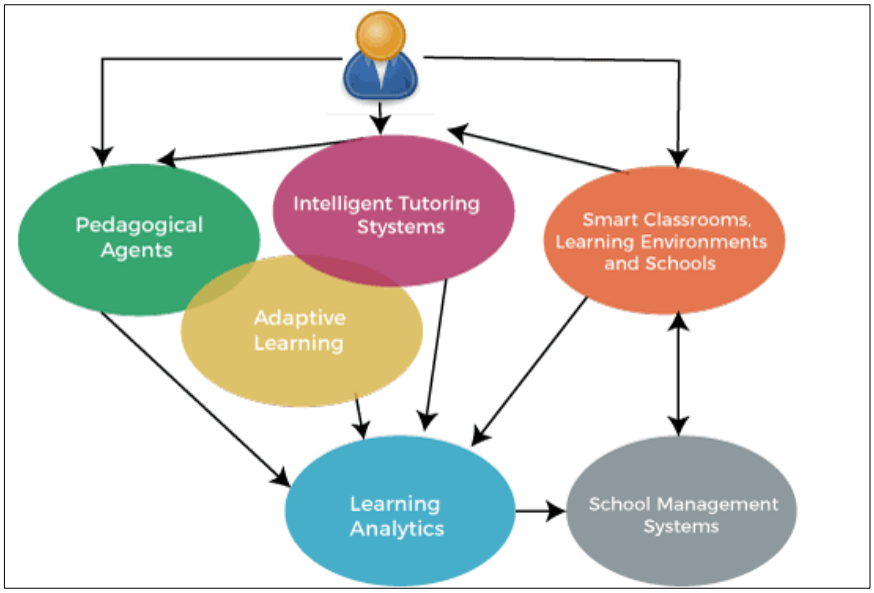

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GREEN IN THE SYNTHESIS OF PHARMACEUTICALS

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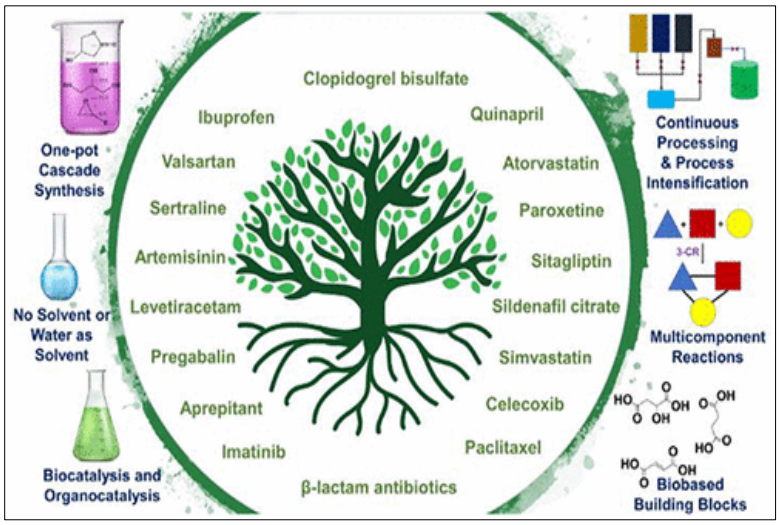
The principles of green chemistry (GC) can be comprehensively implemented in green synthesis of pharmaceuticals by choosing no solvents or green solvents (preferably water), alternative reaction media, and consideration of one-pot synthesis, multicomponent reactions (MCRs), continuous processing, and process intensification approaches for atom economy and final waste reduction. The GC's execution in green synthesis can be performed using a holistic design of the active pharmaceutical ingredient's (API) life cycle, minimizing hazards and pollution, and capitalizing the resource efficiency in the synthesis technique. Thus, the presented review accounts for the comprehensive exploration of GC's principles and metrics, an appropriate implication of those ideas in each step of the reaction schemes, from raw material to an intermediate to the final product's synthesis, and the final execution of the synthesis into scalable industry-based production.

For real-life examples, we have discussed the synthesis of a series of established generic pharmaceuticals, starting with the raw materials, and the intermediates of the corresponding pharmaceuticals. Researchers and industries have thoughtfully instigated a green synthesis process to control the atom economy and waste reduction to protect the environment. We have extensively discussed significant reactions relevant for green synthesis, one-pot cascade synthesis, MCRs, continuous processing, and process intensification, which may contribute to the future of green and sustainable synthesis of APIs.



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CURRENT TRENDS IN PHARMACEUTICAL SCIENCES

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The term "pharmaceutical science" designates a group of academic disciplines that include pharmacoeconomics, clinical sciences, drug delivery, drug action, drug discovery, and design, and regulatory affairs. It mostly focuses on natural medicines, pharmacologically active natural components or their derivatives, and complex traditional medicine formulas.

Pharmaceutical and biological sciences span the entire field of translational science, where basic science research is transformed into fresh approaches to the detection, treatment, and avoidance of human disease. The main purpose of this field is to manage risk associated with drugs and treatments and to provide better options. It also focused on some nanotechnologies and a creative method for discovering novel drugs based on an understanding of a biological target which are help to get more stable and effective bioactive compounds.

The field also focuses on the methods and principles that are applied under controlled circumstances for research projects to evaluate and examine medical treatments. These projects typically combine clinical investigation with health services research that incorporates a variety of principles, including chemistry and medicine. Additionally, research on the creation of innovative carriers or materials for the efficient therapeutic delivery of pharmaceuticals is included. Which describes the methods, formulations, manufacturing processes, storage arrangements, and technology involved in delivering a pharmaceutical chemical to its intended target site. Also, taking an account of comparison of the values of one pharmaceutical drug or drug therapy to another can be considered in this.Now day’s scientists are seeking new bioactive compounds which can be a better choice for new and old diseases. Some older drugs are replaced by newer and better ones.

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MAGNETIC BACTERIA: A GREAT POTENTIAL FOR BIOMEDICINE

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Magnetic bacteria possess extraordinary capabilities due to the magnetic nanoparticles, the magnetosomes, which are concatenated inside their cells. A research team at the University of Bayreuth has now transferred all of the approximately 30 genes responsible for the production of these particles to non-magnetic bacteria in a broad series of experiments. This resulted in a number of new bacterial strains that are now capable of producing magnetosomes. The research findings presented in Nature Nanotechnology are groundbreaking for the generation of magnetized living cells, which have great potential for the development of innovative diagnostic and therapeutic methods in biomedicine. Based on extensive studies, the researchers initially identified 25 species of non-magnetic proteobacteria—by far the most extensive domain of bacteria—that are particularly suitable for gene transfer and for studying magnetosome formation. Both biochemical properties and the availability of specific gene sequences were decisive factors. Magnetization was successful in seven species as these bacteria continuously produce magnetosomes in which iron-containing magnetite crystals are chained together in a manner similar to that in the donor bacterium *Magnetospirillumgryphiswaldense*.

In terms of future applications in biomedicine, it is particularly promising that two species of bacteria that have been successfully genetically engineered are already widely used in biotechnology. According to the current state of research, they are well compatible with human cells. This opens up new perspectives for a variety of biomedical applications e.g., for microrobot-controlled transport of active pharmaceutical ingredients, for magnetic imaging techniques, or even for optimizations of hyperthermia cancer therapy.

Comparison between the genome of these strains and the genome of those genetically modified bacteria that failed to produce magnetosomes has also led to valuable insights. There is much evidence to suggest that the magnetosome formation of transgenic bacterial strains is closely related to their ability to photosynthesize or to engage in oxygen-independent, so-called anaerobic respiration processes.

Magnetic bacteria possess extraordinary capabilities due to the magnetic nanoparticles, the magnetosomes, which are concatenated inside their cells. A research team at the University of Bayreuth has now transferred all of the approximately 30 genes responsible for the production of these particles to non-magnetic bacteria in a broad series of experiments. This resulted in a number of new bacterial strains that are now capable of producing magnetosomes.

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Overall, the new study shows that it is not single or a few particular genes that transgenic bacteria lack when they are incapable of magnetosome formation. Rather, the decisive factor for them to synthesize magnetosomes after receiving the foreign gene clusters is a combination of certain metabolic properties and the ability to efficiently use the genetic information of the foreign genes to produce cellular proteins.

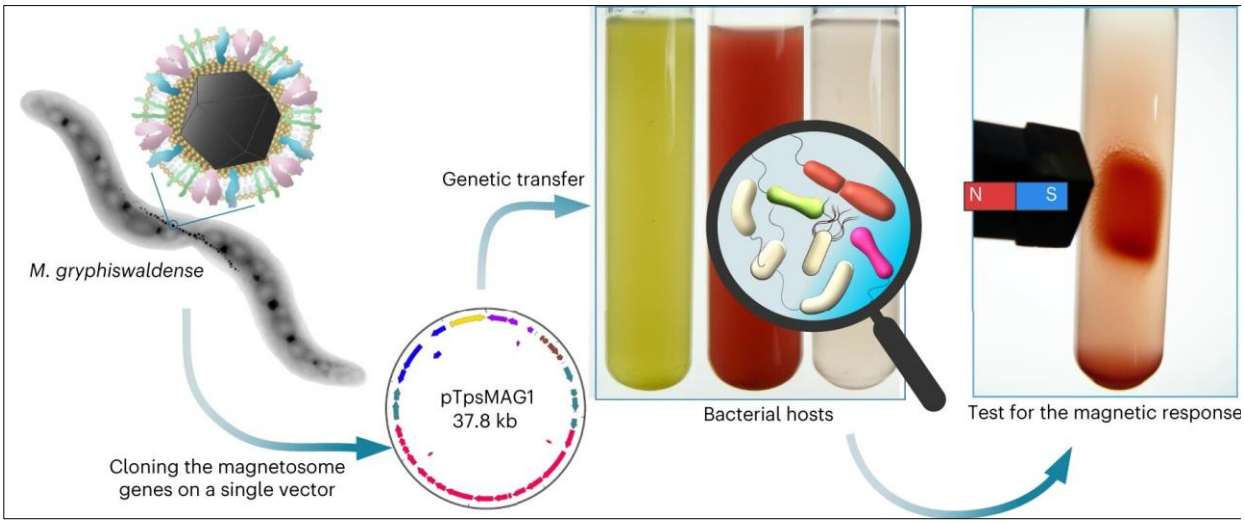

Fig.: Experimental strategy used to survey bacterial hosts for heterologous magnetosome production

The research is needed to understand the biosynthesis of magnetosomes in detail, identify barriers to their transfer, and develop strategies to overcome them. At the same time, however, our results shed new light on metabolic processes that support magnetosome formation. They therefore provide a framework for future investigations on the way to designing new strains of biocompatible magnetic bacteria tailored for biomedical and biotechnological innovations. Previous researchhad succeeded in introducing the genes responsible for magnetosome formation from the bacterium *Magnetospirillumgryphiswaldense*, a model organism for research into the genome of non-magnetic bacteria. However, in only a few cases, this gene transfer resulted in genetically modified bacteria that, in turn, began to form magnetosomes.

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3D PRINTING APPLICATIONS FOR HEALTHCARE RESEARCH AND DEVELOPMENT

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The applications of 3D printing for medical implants are already a thriving industry. This is due to breakthroughs in material design broadening the spectrum of materials that can be 3D printed and the progress of 3D printer technology allowing for the printing of complex biological structures at a microscopic scale. 3D printing allows making complicated things out of less material, such as plastics and metals. Anatomical models are presently one of the most extensively used 3D printing applications in the medical field. Medical computer-aided design (CAD) software and low-cost 3D printers are becoming more widely available, allowing more hospitals to create 3D printing laboratories.

3D printing applications for healthcare research and development:

1. Assisting drug research and manufacturing: 3D printing enables the combination of various medicines and compounds into a single pill, known as “polypill”, which release the right drug at the right time through intelligent design, reducing the number of tablets that one person must swallow, which is especially important in geriatric populations. It might lessen the likelihood of drug mistakes and adverse effects while also boosting treatment efficacy and adherence.
2. Personalised dosage optimization: This technology’s ultimate use will be in personalized dosage optimization. It would be highly beneficial to patients taking drugs with complicated pharmacokinetics. 3D printing has the potential to cut costs, improve patient care, and accelerate the medical innovation value chain at practically every stage.
3. Drug delivery research: 3D printing is also being used in taking up challenges in drug delivery. Drugs may be manufactured in various forms and sizes using a 3D printer and then adjusted to manage drug release. Medicine delivery systems have also been created using 3D printers, with scans of the patient’s body serving as a template. It allows the device to be designed to optimise contact between it and the treated tissue, making it simpler to give an adequate amount of the drug.
4. Advanced pharmaceutical research: Pharmaceutical is another unique field of research for 3D printing. 3D bioprinters provide substantial advantages for drug testing and clinical trials applications. With the rise of 3D printing, it is now possible to bring manufacturing closer to those who need it and create better.
5. Developing a better treatment system: 3D printing has a very high potential for patient participation since it allows for a horizontal approach to developing treatments, surgeries,

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and drugs linked with individual needs like no other technology. Use of 3D printing are more likely to employ cloud, robotics, and IoT technologies

6. Cost-effective approach: 3D printing technologies improve the outcomes and affordability of medical treatments. 3D printing is frequently considered a component of the technology industry and is underappreciated for its remarkable adaptability. 3D printing production is a more cost-effective approach that produces products faster and less human participation. 3D printing technology has many possible uses, including tooling aids, visual and functional prototypes, and end-use items. Cost reductions from reduced operating room time and hospital bed use benefit providers, directly influencing profit margins where reimbursement rates are fixed for a specific treatment.

7. Printing of biological tissue: 3D printing gives patients cheap personalized prostheses, implants, and gadgets every day. It allows doctors to execute their jobs more efficiently with unique tools and models, and it assists medical device firms in developing better goods faster. Some scientists are even developing technology to 3D printed biological tissue and organs. Implants, pros- theses, gadgets, anatomical models, and even specific equipment must be constructed for each patient. This personalization is highly costly and time-consuming if done by using traditional techniques.

8. Skin cell printing: Skin cell bioprinting is being developed today for people suffering from skin diseases, burn, and grafting. Bio-printing is evolving, and skin bioprinting has become a promising research area. 3D printed skin can aid in wound healing. Skin printers can be helpful to save lives. Human skin 3D printing can be a terrific way to test chemicals and develop novel medical therapies. It may even be feasible to customise treatment by generating a 3D skin using the patient's cells. This method must be enhanced, demonstrating that it is possible to 3D print human skin using a small but efficient device.

9. Implants research: With 3D printing, providers could receive implants research more quickly and give better service. Because 3D printing allows for the restoration of highly complicated vascular networks and systems, it may play a role in the fabrication of artificial organs in the future. Using these powerful tools in conjunction with lab created biological material pro- cesses might reduce organ transplant waiting lists and save countless lives.

10. Reducing medical risks and complications: Doctors are tackling demanding operations by developing new surgical instruments that may be used to streamline procedures and improve patient outcomes. 3D printing has enabled designers to produce more effective medical equipment at a lesser cost.

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3DP is widely used in healthcare and research development. Implants and prostheses, the application of models in virtual surgical planning and teaching in healthcare, traditional and novel medical devices, 3DP of drugs are rapidly developing areas of the 3DP applications in medicine. In most fields they offer considerably less expensive alternatives to the classical devices and procedures, release creativity accelerated by the ease of prototyping of novel devices and help through diagnostics and medical procedures. One could call it personalized medicine on the nanoscale.

Fig.: Applications of 3D Printing Technology on Biomedical Products

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REVOLUTIONIZING DRUG THERAPY: THE POWER OF PHARMACOGENOMICS

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In the rapidly evolving landscape of healthcare, pharmacogenomics stands as a beacon of hope and progress. At the heart of this groundbreaking field lies a simple yet profoundly transformative idea: that our genetic makeup plays a pivotal role in how our bodies respond to pharmaceutical drugs. Pharmacogenomics, the science that explores this intricate relationship between genetics and drug therapy, holds immense promise for revolutionizing the way we approach healthcare and drug treatment.

Understanding the Essence of Pharmacogenomics

Pharmacogenomics, often referred to as the science of "personalized medicine," delves into the genetic variations that influence our responses to medications. These variations, known as single nucleotide polymorphisms (SNPs), can substantially impact how drugs are metabolized, absorbed, and interact with our bodies.

Consider a common scenario in clinical practice: the prescription of pain relief medications. For years, healthcare providers have grappled with the variability in patient responses to drugs like codeine. Pharmacogenomics offers a clear and scientifically sound explanation for such differences. Genetic variations in specific genes, such as CYP2D6, can lead to rapid metabolism of codeine in some individuals, resulting in inadequate pain relief. In others, the same genetic variations can cause codeine to accumulate at toxic levels, leading to severe adverse reactions. Pharmacogenomics empowers healthcare providers to decipher these genetic codes and make precise drug therapy decisions tailored to each patient's unique genetic profile.

The Power of Personalization

One of the most compelling aspects of pharmacogenomics is its ability to personalize drug therapy like never before. No longer are treatment decisions solely based on population averages; instead, they are fine-tuned to an individual's genetic blueprint. This level of personalization goes beyond choosing a medication; it involves selecting the most appropriate drug and dosage based on the patient's genetic characteristics. This individualized approach has profound implications for complex medical conditions where a "one-size-fits-all" strategy may fall short. In the realm of mental health, for instance, antidepressant medications have historically been prescribed through a process of trial and error.

Patients may cycle through multiple medications, each with its own set of side effects and varying levels of effectiveness. Pharmacogenomics is changing this paradigm by enabling healthcare providers to analyze a patient's genetic profile and select antidepressants more likely to be

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This not only expedites the path to recovery but also reduces the burden on patients and the healthcare system.

Minimizing Adverse Reactions, Maximizing Efficacy

One of the most promising outcomes of pharmacogenomics is its potential to reduce adverse reactions and enhance drug efficacy. Adverse reactions to medications are not uncommon and can range from mild discomfort to severe, even life-threatening, conditions. By tailoring drug therapy to an individual's genetic makeup, pharmacogenomics helps mitigate the risk of adverse reactions, thus improving patient safety and tolerability.

Furthermore, this personalized approach significantly increases the likelihood of a drug's effectiveness. When the right drug and dosage are chosen based on genetic insights, patients are more likely to experience the intended therapeutic benefits. This not only improves patient outcomes but also reduces the need for multiple medication adjustments and the associated frustration and uncertainty for both patients and healthcare providers.

The Road Ahead: A Glimpse into the Future

Pharmacogenomics has undoubtedly made remarkable strides, but its journey has only just begun. As genetic research continues to advance, our understanding of the intricate relationship between genetics and drug responses will deepen. This will open doors to even more precise drug therapies and novel treatments across a wide range of medical conditions.

Additionally, the integration of pharmacogenomics into routine clinical practice is on the horizon. As genetic testing becomes more accessible and cost-effective, it is poised to become a standard part of patient care. This shift will empower healthcare providers with valuable information to make informed treatment decisions, ultimately benefiting patients by reducing adverse reactions, improving efficacy, and enhancing overall healthcare experiences.

Ethical and Regulatory Considerations

While the promise of pharmacogenomics is immense, it also brings forth a set of ethical and regulatory considerations. Genetic testing, which forms the foundation of pharmacogenomics, involves sensitive and personal information. Questions surrounding data privacy, consent, and the responsible use of genetic information have emerged as important ethical considerations.

Furthermore, the regulatory landscape for pharmacogenomics is evolving. Governments and healthcare regulatory bodies are actively working to establish guidelines and standards for the responsible integration of pharmacogenomics into clinical practice. Striking a balance between facilitating innovation and ensuring patient safety will be crucial in shaping the future of pharmacogenomics.

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Realizing the Potential of Pharmacogenomics

In conclusion, pharmacogenomics is revolutionizing drug therapy by harnessing the power of genetics to individualize treatment plans. Its impact on healthcare is transformative, offering the potential to optimize drug efficacy, reduce adverse reactions, and ultimately improve patient outcomes. As pharmacogenomics continues to evolve and integrate into routine clinical practice, it promises a future where personalized medicine becomes the standard, ushering in an era of safer, more effective, and patient-centered healthcare.

However, realizing the full potential of pharmacogenomics will require collaboration between healthcare professionals, geneticists, policymakers, and the pharmaceutical industry. It is a journey that will undoubtedly present challenges but also offers a glimpse into a future where every patient receives precisely the right treatment, at the right time, for the best possible health outcomes.

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Synthesis, Characterization‘ADMET-SAR’ Prediction, DPPH Assay, and Anti-Mycobacterium Study of 4-[(substituted benzyl) amino]benzo hydrazides and its Hydrazones as the Acyl-CoA Carboxylase, AccD5 Inhibitors

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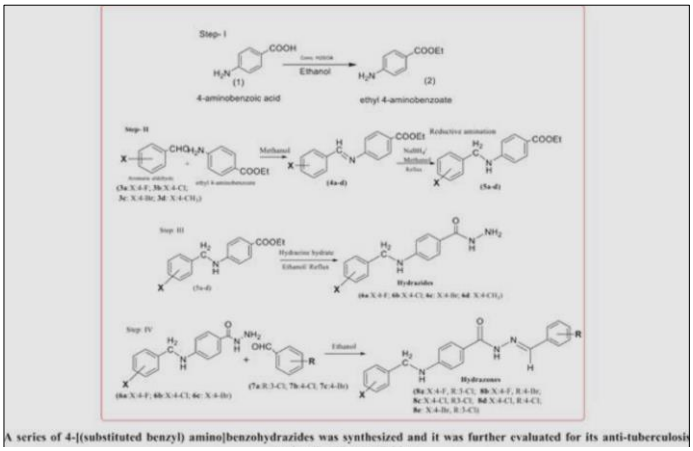
Hydrazide-hydrazone derivatives have shown diverse biological activities, such as antitubercular (anti-TB), antibacterial, antifungal, anticancer, anti-inflammatory, antiviral, and antiprotozoal actions. Hydrazide–hydrazones contain azomethine (-NH-N=CH-) group connected with carbonyl group and are believed to be responsible for various pharmaceutical applications. They aid in the synthesis of different five-membered heterocyclic systems, such as oxadiazole, triazoles, etc. In the present study, various hydrazines/hydrazones were synthesized starting from 4- amino benzoic acid derivatives. Structures of all 9 newly synthesized compounds (6a-6d and 8a- 8e) were further characterized by using various spectroscopic methods, such as 1H-NMR (Nuclear Magnetic Resonance), FT-IR (Fourier-transform infrared spectroscopy), Gas chromatographymass spectrometry (GC-MS), etc. Furthermore, molecular docking analysis against the acyl-CoA carboxylase, AccD5 (PDB ID: 2A7S), was also carried out using the Glide module, which depicted good binding scores than standard drugs. The anti-tuberculosis activity of all the hydrazides and hydrazones (6a-6d and 8a-8e) were evaluated against the Mycobacterium tuberculosis H37 RV strain using the Alamar-Blue susceptibility (MABA) test. The activity was expressed as the minimum inhibitory concentration (MIC) in µg/mL values. The antioxidant activity was also carried out using a DPPH assay.

Our findings demonstrated highly encouraging in-vitro results (MABA assay, MIC: 1.2 µg/mL) of hydrazones as depicted by good antimycobacterial activity. The antioxidant results showed a moderate to a good percentage of DPPH inhibition. Our in-silico ADMET analysis further suggested good pharmacokinetic and toxicity-free profiles of synthesized analogues (6a-6d and 8a-8e). Our results signify hydrazones/hydrazines as potential hit candidates against the future developments of potent and safer anti-TB agents.



A series of 4-[(substituted benzyl) amino]benzohydrazides was synthesized and it was further evaluated for its anti-tuberculosis

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RECENT DEVELOPMENTS IN SONOCHEMICAL SYNTHESIS OF NANOPOROUS MATERIALS

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Ultrasounds are commonly used in medical imaging, solution homogenization, navigation, and ranging, but they are also a great energy source for chemical reactions. Sonochemistry uses ultrasounds and thus realizes one of the basic concepts of green chemistry, i.e., energy savings. Moreover, reduced reaction time, mostly using water as a solvent, and better product yields are among the many factors that make ultrasound-induced reactions greener than those performed under conventional conditions. Sonochemistry has been successfully implemented for the preparation of various materials; this review covers sonochemically synthesized nanoporous materials. For instance, sonochemical-assisted methods afforded ordered mesoporous silicas, spherical mesoporous silicas, periodic mesoporous organosilicas, various metal oxides, biomass-derived activated carbons, carbon nanotubes, diverse metal-organic frameworks, and covalent organic frameworks.

Sonochemical Equipment

There are a few types of reactors for ultrasound-assisted syntheses, such as ultrasonic baths, ultrasonic probes (horns), longitudinal horns, and multiple transducers. These reactors differ in the way they introduce ultrasounds into a reacting system. For instance, ultrasonic baths introduce energy into the system through water and reaction vessel walls, while ultrasonic probes introduce the energy directly into the system, which is more desirable when localized energy is required. Multiple transducers, as well as longitudinal horns, are preferable for large-scale applications. Schemes of the sonochemical reactors are presented in Figure 1B. The basic element of sonochemical devices is a transducer that converts mechanical or electrical energy into ultrasounds. The most common are piezoelectric transducers made of barium titanate, lead methaniobate, or other piezoelectric materials. They can work in the entire range of ultrasonic frequencies, which is the key parameter influencing the course of the synthesis. Namely, high frequencies (above 100 kHz) are appropriate for the chemical effect, while the lower frequencies are preferable for physical effects. It should be remembered that there are many other important parameters affecting the sonochemical synthesis, including mass transfer, mixing time, flow diagram, and solvent type. For example, solvents with low surface tension support bubble growth, though they reduce cavitation intensity.

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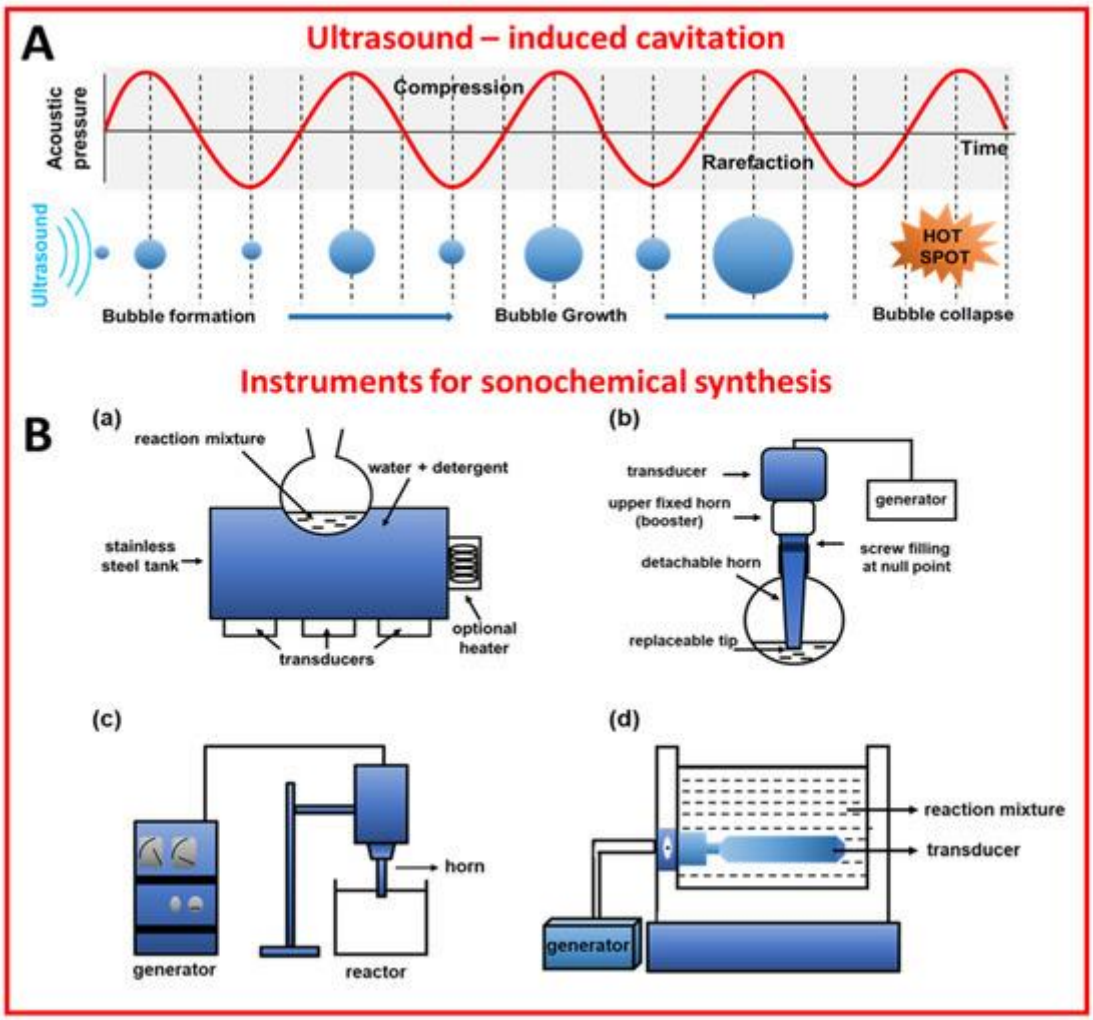

Fig.: (**A**) Schematic illustration of ultrasound-induced cavitation [**6**]. Reproduced with permission from ref. [**6**], licensed under CC-BY. (**B**) Schematic illustration of the instruments for sonochemical synthesis: (**a**) cleaning bath, (**b**) probe system [**12**], (**c**) horn reactor [**14**], and (**d**) longitudinal horn reactor [**14**]. Reproduced with permission from ref. [**12**]. Copyright 2002, Blackwell Science Ltd. Reproduced with permission from ref. [**14**]. Copyright 2011, Elsevier B.V.

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3D PRINTING OF CUSTOM DRUG DOSAGES: A REVOLUTION IN PERSONALIZED MEDICINE

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Introduction

The traditional "one-size-fits-all" approach to drug manufacturing has been undergoing a paradigm shift with the advent of 3D printing technology. 3D printing, or additive manufacturing, offers the ability to create custom drug dosages tailored to individual patient needs, bringing us a step closer to the ultimate goal of personalized medicine. This article delves into the potential and the challenges of using 3D printing for crafting custom drug dosages.

The Technology

In the realm of pharmacy, 3D printing employs techniques such as fused deposition modeling (FDM), selective laser sintering (SLS), and inkjet-based methods. Here, drug formulations and polymers are combined to form printable "inks." During the printing process, these inks are carefully layered to produce a tablet or other drug form with precise dimensions and active pharmaceutical ingredient (API) concentration.

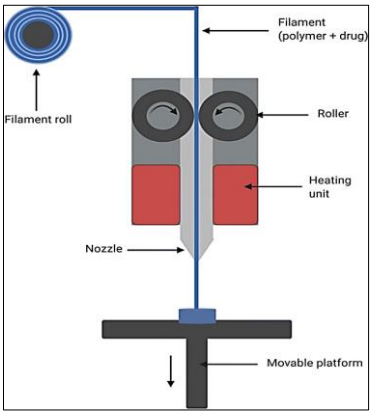

Fig.: Schematic of fused deposition modeling

Benefits

Customization

Traditional drug manufacturing processes are not adept at producing unique dosages for each patient. 3D printing, however, allows for customization at an unparalleled level. For example, pediatric and geriatric patients, who often require lower and finely tuned doses, can benefit immensely from this technology.

Complexity and Combination Therapies

3D printing can manufacture complex geometric shapes that facilitate controlled release profiles. Furthermore, it enables the production of polypills, which contain multiple active ingredients, enhancing medication adherence for patients on combination therapies.

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Rapid Prototyping

3D printing can accelerate the drug development process by allowing rapid prototyping. This is particularly advantageous in creating 'orphan drugs' for rare diseases, which are often not economically viable to produce on a large scale using conventional methods.

Challenges and Concerns

Regulatory Hurdles

The FDA approved its first 3D-printed drug, Spritam, in 2015, but the regulatory landscape remains complex. Ensuring consistency, quality, and safety in 3D-printed medications is a paramount concern.

Cost and Accessibility

While 3D printers have become more affordable, the initial setup, material costs, and specialized training make it a significant investment. Moreover, the technology is yet to be universally accessible, especially in resource-poor settings.

Conclusion

3D printing holds the potential to revolutionize the field of pharmacy by enabling custom drug dosages tailored to individual patient needs. While the technology promises numerous benefits, from customization to rapid prototyping, it must overcome regulatory and accessibility hurdles to realize its full potential in mainstream pharmaceutical practice.

The ongoing research and pilot projects in this arena are paving the way for a future where medicine is as unique as the individuals it treats, aligning perfectly with the evolving paradigms of patient-centered care and personalized medicine.

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SCIENTISTA CREATE HUMAN EMBRYO IN LAB WITHOUT EGGS AND SPERM

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Researchers at Israel's Weizmann Institute of Science have successfully created synthetic models of 14-day old human embryos derived entirely from stem cells grown in a lab. The models accurately emulated embryonic development in its earliest stages - a process still poorly understood due to ethical constraints on real embryo research. The breakthrough, reported in the journal Nature, provides an unprecedented glimpse into the mysterious earliest stages of human development and could open up new avenues of research into infertility, birth defects, and organ growth.

Led by molecular biologist Professor Jacob Hanna, the Weizmann team started with two types of stem cells - those reprogrammed from adult skin cells and others derived from established lab-grown stem cell lines. Using a specialized technique developed by Hanna in 2013, they reverted the cells to an earlier, more flexible “naive” state resembling a 7-day-old embryo ready for implantation. The naive stem cells were separated into three groups - embryo, yolk sac and placenta - and treated with chemicals to nudge them towards their respective fates. When combined in optimized conditions, around 1% self-organized into sphere-shaped synthetic embryos exhibiting the complex architecture of a 14-day-old human embryo. Crucially, these synthetic models contained structures previous stem cell-derived aggregates lacked, including the placenta, yolk sac, chorionic sac and hormone-producing cells.

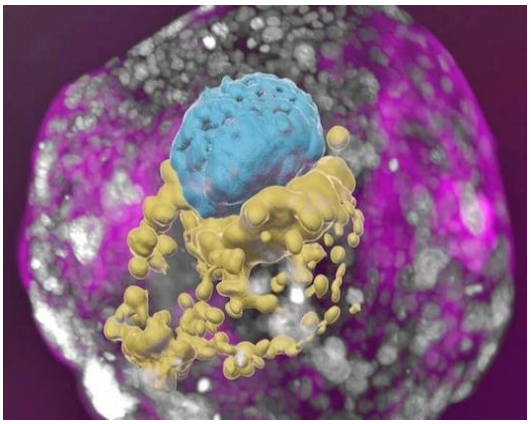

Fig.: A stem cell–derived human embryo model at a developmental stage equivalent day 14 embryo

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Under the microscope, their internal organization matched human embryo diagrams, convincing the researchers their 14-day milestone had been authentically reached. According to Hanna, the first month marks a critical yet little understood period when the implanted cell clump becomes a structured embryo containing every organ. “Our stem cell-derived model offers an ethical route to study this ‘black box’ phase by closely mimicking natural development.”

Already, his team has gleaned new insights into early pregnancy loss by observing developmental abnormalities when embryos were improperly enveloped. Further research using the accurate models could uncover causes of infertility and birth defects, aid drug safety tests, and boost efforts to grow transplantable tissues and organs.

By ethically avoiding the use of fertilized eggs, Hanna’s synthetic embryos enable human development to be scientifically investigated beyond the 14-day legal limit. This breakthrough opens up new possibilities. These models will help reveal the complex forces driving early embryonic growth.”

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EMERGENT TECHNOLOGICAL ADVANCES IN HOME HEALTH CARE

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Telehealth, is health care facilitated by telecommunications technology—has begun to transform the home care landscape and promises to grow substantially in coming years. Currently, simple technologies (e.g., e-mail, the Internet, cell phones) can be used to monitor people's health at a distance. High-resolution visual images and audio can be transmitted through telephone lines or broadband connections. In coming years, remote monitoring will increase dramatically and will involve more types of equipment in the home; technologies such as wireless electronics and digital processing will support communication between a diverse set of devices and remote health care providers. Some wireless devices, especially meters and monitors, will be wearable, which will make constant monitoring possible or intermittent testing more convenient.

Telehealth technologies can be used to support adherence to treatment regimens, facilitate self-care, and provide patient education. Cameras and sensors can be used to track patient movements and behaviors in the home. Monitors can collect and transmit a variety of data to health care providers at a distance, eliminating the need to visit a clinic or to call in. These technologies can also provide reminders to people at home, such as to take medications, measure their blood pressure, perform physical therapy, or schedule follow-up appointments.

Future technological advances will bring new devices, such as improved pacemakers, cochlear implants, and medicine delivery systems. Miniaturization of various components, including microprocessors and nanotechnology, will make possible advances to many types of medical devices used inside and outside formal health care settings.

Some devices envisioned will be embedded in common household objects like Biosensing chip in a toothbrush that will check blood sugar and bacteria levels, Smart bandages made of fiber that will detect bacteria or a virus in a wound and then recommend appropriate treatment, Smart T-shirts that will monitor the wearer's vital signs in real time, Heads-up displays for glasses that use pattern recognition software to help people remember human faces, inanimate objects.

Novel handheld devices may provide new capabilities for home health care, such as skin surface mapping, an imaging technology that will track changes in moles to detect malignancies; biosensors that will perform as portable laboratories; and alternative input devices such as eye blinks (electromyography) or brain activity (electroencephalography) that will facilitate hands-free device control, which will be especially useful for people with limited use of their hands (e.g., people with paralysis or arthritis). Some people envision a future with more consumer-driven, preventive medicine in which consumers can evaluate their own bodies and communicate

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with health care professionals on an ongoing or as-needed basis.

Other people are less optimistic that the nation will ever get to a preventive medicine model of health care, given the current business model being followed in the United States. The reality will probably fall between the two extremes, with some portion of the U.S. population making good use of new opportunities to follow good health maintenance practices. If medical devices are well-designed with appropriate and effective application of human factors principles and methods that percentage can be maximized.

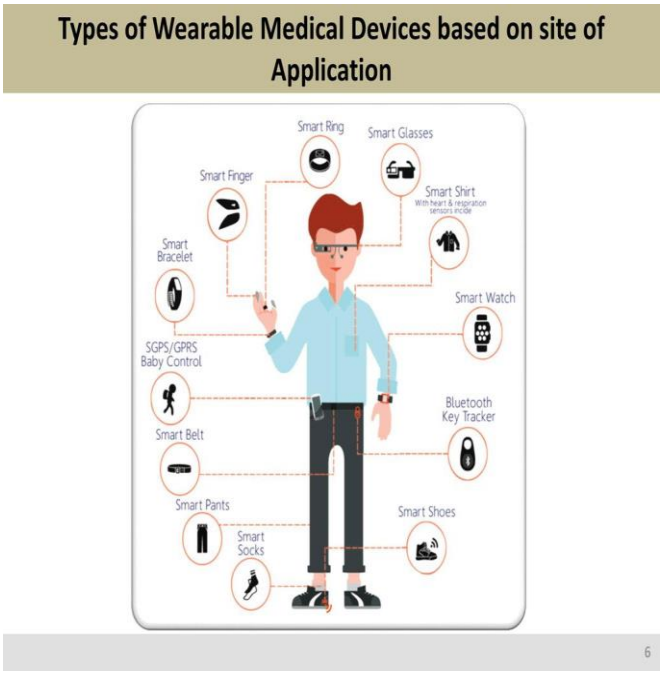

Fig.: Type of wearable medical devices based on site of application

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VACUUM FOAM DRYING: A GAME-CHANGER IN PHARMACEUTICAL MANUFACTURING

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1. Introduction

The pharmaceutical industry is in a perpetual state of evolution, constantly driven by innovation. Among the multitude of technological advancements, vacuum foam drying has emerged as a revolutionary method that promises to redefine pharmaceutical drying processes. This article takes an in-depth look at vacuum foam drying and its profound potential to reshape pharmaceutical drying by enhancing efficiency, elevating product quality, and promoting sustainability.

2. The Fundamentals of Vacuum Foam Drying

2.1 Understanding Vacuum Foam Drying: Vacuum foam drying is a cutting-edge technique that merges the benefits of vacuum drying with foam technology, creating a unique and versatile approach to drying pharmaceutical products, especially those containing active pharmaceutical ingredients (APIs).

2.2 The Intricate Process: The vacuum foam drying process initiates with the generation of a stable foam, typically using a foam generator. This foam comprises minute air bubbles dispersed within a liquid phase that often contains the pharmaceutical product. Subsequently, the foam is introduced into a vacuum chamber, where reduced pressure promotes the evaporation of moisture from the foam. As moisture evaporates, it is swiftly extracted by the vacuum, leaving behind a thoroughly dried product.

3. Unpacking the Advantages of Vacuum Foam Drying

3.1 Elevated Product Quality: One of the most significant advantages of vacuum foam drying lies in its gentle approach to drying sensitive pharmaceutical compounds. Traditional drying methods often expose these substances to harsh conditions, such as high temperatures, leading to potential degradation and loss of efficacy. In contrast, vacuum foam drying operates at lower temperatures, significantly diminishing the risk of product damage and ensuring consistent, high-quality outcomes.

3.2 Energy Efficiency: A Green Approach: The incorporation of vacuum in the drying process reduces the energy requirement for moisture removal. This inherent energy efficiency translates into substantial cost savings and a reduced environmental footprint. This aligns seamlessly with the pharmaceutical industry's burgeoning focus on sustainability, where minimizing energy consumption and waste production is paramount.

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3.3 Impeccable Uniformity: Vacuum foam drying excels in delivering superior drying uniformity. The foam matrix ensures that every part of the product is exposed to the same drying conditions, virtually eliminating the risk of uneven drying or clumping, which is commonplace in conventional drying processes. This consistency in drying contributes to product homogeneity and overall quality.

3.4 Adaptability and Scalability: An alluring feature of vacuum foam drying is its remarkable versatility. It can be tailored to accommodate a wide spectrum of pharmaceutical products, ranging from powders and granules to delicate biopharmaceuticals. Furthermore, this technology is scalable, making it applicable for both small-scale research endeavors and large-scale production operations.

4. Applications and Future Prospects

4.1 Applications across Industries: While vacuum foam drying has gained prominence in the pharmaceutical sector, its applicability extends beyond drug manufacturing. This versatile technology is also relevant in food processing, cosmetics production, and biotechnology. In the pharmaceutical sphere, it has proven particularly valuable for drying vaccines, antibodies, and other biopharmaceuticals.

4.2 The Promising Horizon: The future of vacuum foam drying within the pharmaceutical industry holds tremendous promise. Ongoing research and development initiatives aim to optimize the process further and expand its applicability. This includes exploring innovative foaming agents and advanced control systems to fine-tune the drying process. Moreover, collaborative efforts between pharmaceutical companies and technology providers are poised to accelerate innovation in this field.

As the pharmaceutical industry continuously prioritizes product quality, efficiency, and sustainability, vacuum foam drying emerges as a pivotal tool to meet these objectives. Its capability to gently and efficiently dry sensitive pharmaceutical compounds not only makes it a valuable addition to the industry's toolkit but also positions it as a cornerstone in the quest for excellence.

5. Conclusion

In the dynamic realm of pharmaceutical technology, vacuum foam drying shines as a transformative force. Its capacity to elevate product quality, reduce energy consumption, and ensure uniform drying distinguishes it as an indispensable asset for pharmaceutical companies committed to excellence.

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As research and development endeavors continue to refine this groundbreaking technology, the horizon gleams with potential for vacuum foam drying to revolutionize pharmaceutical drying processes, fostering growth, and sustainability in the industry. In summary, vacuum foam drying is not merely an innovation; it's a paradigm shift in the art of pharmaceutical drying.

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Technical Articles

THE TRANSFORMATIVE POWER OF INDUSTRIES AND THEIR EVOLVING PHASES

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The concept of industry is synonymous with the transformation of raw elements into valuable products and services. This process involves multiple steps, from manufacturing and processing to assembling, packaging, and distributing. Over time, industries have been instrumental in shaping the economic trajectories of nations, providing job opportunities, advancing technology, and elevating living standards. Each significant transformation in the industrial sector is described as an "Industrial Revolution."

The Inception of Mechanized Production: Industry 1.0

The first phase, commonly referred to as Industry 1.0 or the initial Industrial Revolution, came to prominence in the late 1700s and persisted until the mid-1800s. It revolutionized traditional craftsmanship by introducing mechanization, leveraging energy sources like coal and steam, and giving rise to the first factory systems. This epoch allowed for the mass manufacturing of goods and birthed early industrial powerhouses like textile mills and iron foundries. Around the same time, early pharmaceuticals were making strides, shifting from herbal medicine to more standardized compounding practices. The early years of pharmaceuticals were characterized by a focus on natural remedies, often prepared by pharmacists through a process called compounding. Herbs and minerals were sourced, processed, and often combined to treat various ailments. These were the first steps toward standardizing medical treatments, and they laid the groundwork for the pharmaceutical giants of the future.

The Expansion of Mass Production: Industry 2.0

The second wave, termed Industry 2.0, was hallmarked by the electrification of factories and technological marvels like the assembly line. The era led to substantial gains in production efficiency and quality and introduced new sectors such as automotive manufacturing. The second phase of the pharmaceutical industry began with the onset of industrial-scale production techniques. This was marked by the introduction of synthetic compounds and the emergence of pharmaceutical companies that could mass-produce medicines with standardized dosages. New regulatory bodies were formed to ensure safety and efficacy, and this era saw the development of iconic drugs like penicillin and aspirin.

The Advent of the Digital Era: Industry 3.0

Also known as the digital revolution, Industry 3.0 was propelled by electronic advancements to facilitate automated, computer-aided production systems. This phase paved the way for the internet, 3D printing, big data analytics, and cloud storage solutions.

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In pharmaceuticals, biotechnology became the focus, allowing for medicines based on living organisms and the onset of personalized medicine. Genetic engineering and personalized medicine became buzzwords, as it became increasingly possible to tailor therapies to individual genetic makeups. Automation and computer-based algorithms also began to play roles in drug discovery and the development of treatments.

The Fusion of Automation and Data: Industry 4.0

Starting in the early 21st century, Industry 4.0 blends automation with data exchange to facilitate the Internet of Things (IoT), artificial intelligence (AI), and machine learning technologies. Factors driving this industrial phase include the quest for greater efficiency and the adoption of novel technologies like AI and IoT, allowing for more rapid and accurate data management and streamlined production. In Pharmaceuticals, the uses of machine learning and AI led to faster and more accurate drug development.

The Synergy of Man and Machine: Industry 5.0

Often called the Human-Tech Partnership, Industry 5.0 aims to harmonize advanced technologies and human skills. By fostering a collaborative environment where machines handle monotonous and hazardous tasks and humans contribute creativity and problem-solving, the industry is moving towards greater efficiency, social responsibility, and customization. The pharmaceutical industry is also expected to witness a blend of human and technological capabilities, particularly in ethical drug discovery and patient care. AI will sift through potential drug candidates, but human expertise will be essential for nuanced understanding and ethical considerations. We can anticipate the rise of decentralized clinical trials, virtual healthcare interactions, and smart diagnostics with real-time monitoring.

Key Features of Industry 5.0:

Collaboration: A focus on human ingenuity combined with machine efficiency.

Customization: The tailoring of products and medical treatments to individual consumer needs.

Sustainability: A commitment to eco-friendly practices in both manufacturing and drug development.

Decentralization: The move towards localized production in general industry and decentralized clinical trials in pharmaceuticals.

Industry 5.0 presents an exciting frontier, promising enhanced productivity and groundbreaking business models, all while emphasizing sustainability and social responsibility.

The Next Frontier: Industry 6.0

Conceptually known as the sixth industrial revolution, Industry 6.0 builds on the previous architecture but incorporates emerging technologies like quantum computing for complex

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biological simulations, nanotechnology for targeted drug delivery, and block chain for transparent, immutable health records.

These advances promise innovative solutions, new business opportunities, and increased safety in production environments. The focus will likely be on solving the 'unsolvable' in medical science, perhaps making strides in currently untreatable conditions or diseases.

However, like all technological shifts, Industry 6.0 also presents potential downsides. These include threats to employment, environmental sustainability, and the equitable distribution of technological gains.

Addressing Future Challenges

While these advancements offer incredible potential, they come with challenges. The ethical considerations around AI and patient data, the potential for job loss due to automation, and the environmental impact of high-tech manufacturing are all considerations that must be addressed. Policymakers, alongside industry leaders, will need to collaborate to create a framework that supports innovation while also considering societal and environmental impacts.

The pharmaceutical industry, like many others, is a story of constant evolution. With the advent of new technologies and methodologies, each phase presents its own challenges and opportunities. The sector is uniquely positioned to benefit humanity, offering the prospect of improved health and well-being for people across the globe. But as the industry advances, it's crucial that it evolves responsibly, keeping the betterment of human society as its guiding principle.

In summary, each industrial revolution—from mechanized production to the promise of quantum computing—offers unique opportunities and challenges. The focus remains on navigating these advancements responsibly to create a more sustainable, efficient, and equitable world.

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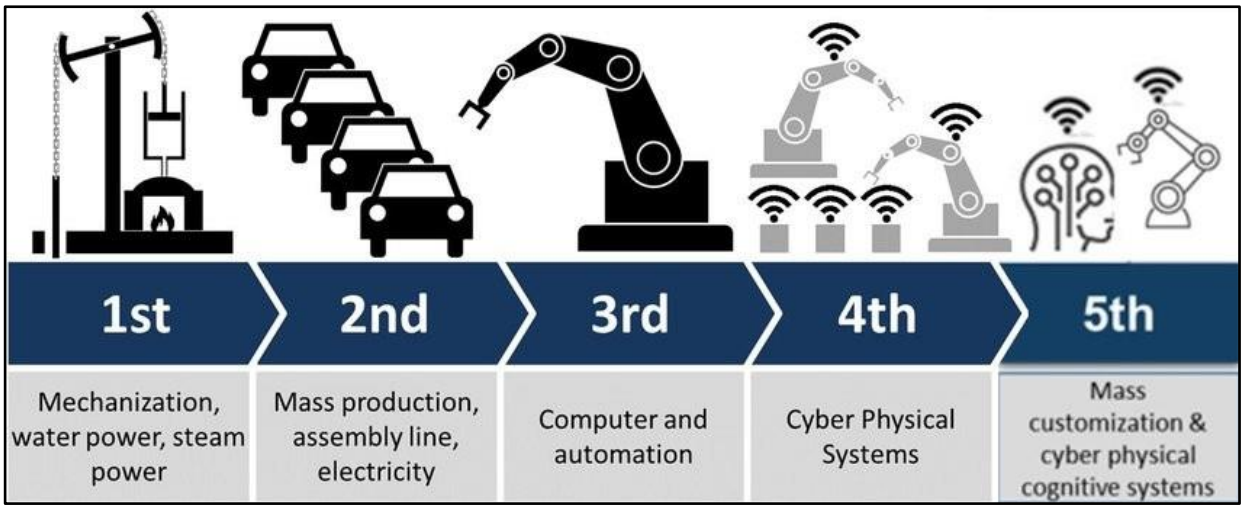

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Technical Articles

Novel 2, 4's Synthesis and Molecular Modelling Studies Potential Anti-Tubercular Agents - Disubstituted -1, 5 -Diphenyl -1-H- Imidazole Derivatives

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A valuable contribution to the chemistry of heterocycles is the investigation of a straightforward molecule with various functionalities for the synthesis of heterocycles. Due to its exceptional biological activity, the imidazole nucleus in general and its chemistry have received significant attestation over the years. A number of new compounds, including 2, 4-disubstituted 1, 5-diphenyl substituted 1, H-imidazole derivatives, and their molecular modelling investigations as anti-tubercular drugs have recently been reported. IR, 1H NMR, and mass spectra were used to characterise the synthesised molecules. Compounds A-IVn, B-IVe, B-IVf, B-IVg, B-IVj, B-IVk, B-IVm, B-IVn, C-IVa, C-IVc, revealed the potent anti-tubercular action at (100 µg/ml, 50 µg/ml, 25 µg/ml, 12.5 µg/ml, 6.25 µg/ml, 3.12µg/ml, 1.6 µg/ml) concentration. According to the findings, substances comprising diphenyl substitution with 2-F, 3-NO2, 2-Cl, 4-Br, 3-OH, 4-OCH3, 4-NO2, 3-Cl, P-dimethylamino, and 2,4-dinitro shown strong anti-tubercular activity. The results of the current study demonstrated that all of the synthetic 2,4-disubstituted 1, 5 -diphenyl substituted 1, H-imidazole derivatives were tested for in vitro anti-tubercular activity against Mycobacterium tuberculosis H37Rv using the Alamar Blue susceptibility test using Microplate Alamar Blue Assay (MABA). Furthermore, minor changes to the substituents on the imidazole nucleus can be made to potentially boost activity. The effectiveness of numerous recent medication innovations involving imidazole derivatives has improved. The significance of aromatic or groups with higher lipophilicity for the anti-tubercular activity of imidazole derivatives was also highlighted by QSAR and pharmacophore analysis. This change on the imidazole moiety showed significant biological action, as of yet. It will be fascinating to see how these alterations are used to create future compounds that are highly effective against tuberculosis.

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Patent Granted -2024

EUTECTIC MIXTURE AND PROCESS OF PREPARING THEREOF

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पेटेंट प्रमाण पत्र | Patent Certificate

(पेटेंट नियमावली का नियम 74) | (Rule 74 of The Patents Rules)

पेटेंट सं. / Patent No.	:	531924
आवेदन सं. / Application No.	:	202121023879
फाइल करने की तारीख / Date of Filing	:	28/05/2021
पेटेंटी / Patentee	:	1.JADHAV Namdeo Ramhari 2.PATIL Udaykumar Sayajirao

प्रमाणित किया जाता है कि पेटेंटी को, उपरोक्त आवेदन में यथाअभिदर्शित *EUTECTIC MIXTURE AND PROCESS OF PREPARING THEREOF* नामक आविष्कार के लिए, पेटेंट अधिनियम, 1970 के उपबंधों के अनुसार आज तारीख मई 2021 के अट्ठाईसवें दिन से बीस वर्ष की अवधि के लिए पेटेंट अनुदत्त किया गया है।

It is hereby certified that a patent has been granted to the patentee for an invention entitled *EUTECTIC MIXTURE AND PROCESS OF PREPARING THEREOF* as disclosed in the above mentioned application for the term of 20 years from the 28th day of May 2021 in accordance with the provisions of the Patents Act,1970.

अनुदान की तारीख : 05/04/2024
Date of Grant :

पेटेंट नियंत्रक
Controller of Patents

टिप्पणी - इस पेटेंट के नवीकरण के लिए फीस, यदि इसे बनाए रखा जाना है, मई 2023 के अट्ठाईसवें दिन को और उसके पश्चात प्रत्येक वर्ष में उसी दिन देय होगी।

Note. - The fees for renewal of this patent, if it is to be maintained, will fall / has fallen due on 28th day of May 2023 and on the same day in every year thereafter.

Technical Articles

Patents from College

Sr. No.	Title	Status Granted/Publication Date	Names of Faculty	Date with National/International
1.	A topical skin tissue regeneration composition of bael fruit gum material, chitosan and gelatin	Filled 202421007438	Dr. D. T. Gaikwad	03/02/2024 National
2.	A posaconazole nanosuspension composition and its preparation process by solvent-antisolvent precipitation for enhanced oral bioavailability.	Published	Dr. M. S. Bhatia, Dr. P. B. Choudhari	11/8/2023 National
3.	A FA-CS-DS-Nanoparticles composition and its synthesizing process thereof	Granted 2023/00808	Dr. M. S. Bhatia	29/3/2023 International
4.	A system for the pharmacological evaluation of conjugates of atenolol with modified saccharides for cardiovascular targeting	Granted 202023100257	Dr. M. S. Bhatia	07/2/2023 International
5.	Coolant Liquid Assembly for Preservation of API	Granted 6294311	Mr. R. J. Jarag	13/07/2023 International
6.	Formulation and Evaluation of Enalapril Loaded Solid Lipid Nanoparticles for Therapeutic Application	Published 202321040518 A	Dr. D. A. Bhagwat	04/08/2023 National
7.	Advanced Liquid Chromatography Apparatus	392021-001 (Design)	Dr. F. A. Tamboli	5/8/2023 National
8.	Portable Lyophilizer for Improving Stability of Compounds	Granted 6303370	Dr. D. A. Bhagwat	22/8/ 2023 International
9.	Novel Menstrual Regulation Activity Of Macrotyloma Uniflorum On Albino Rats	Published 202321051150	Mr. R. J. Jarag, Mrs. R. R. Jarag	22/09/2023 National
10.	Novel Ketoconazole loaded NLC Gel for management of Skin Diseases	Published 202321043227 A	Dr. A. A. Hajare, Dr. H. N. More	15/09/2023 National
11.	AI Based Pill Dispensing Device	Granted 6322573	Dr. F. A. Tamboli	29/10/2023 National
12.	Construction of Curcumin-Bael Fruit Gumelectrospun Nanofibers	Published 202221030754	Dr. D. T. Gaikwad	30/05/2022 National
13.	Analytical Method For Beta-Secretase Estimation From Biological Fluids.	Published 201721033863	Dr. M. S. Bhatia, Mr. R. P. Dhavale	25/02/2022 National
14.	An Empirical System For Risk Assessment Of Mental Illness Disorders Using Neural Network Diagnostic	Granted South Africa Patent Application No 2022/02141 09/12/2021	Dr. D. A. Bhagwat	12/02/2022 National

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15.	Virtual Doctor to Detect Patent Heart Beat and Body Temperature Monitoring	Granted Indian Patent Application No. 202141057189	Dr. D. A. Bhagwat	04/02/2022 National
16.	A Tissue- Based Study For Analysing The Effect Of Drugs Applied Externally	Published 202221007261	Ms. S. A. Thorat	10/02/2022 National
17.	A Process For Preparing Stable Sustained Release Topical Composition Of Euphorbia Tithymaloides.	Published 202221024039	Ms. S. A. Thorat	06/05/2022 National
18.	Novel nanoemulgel formulation containing extract of *Clerodendrum inerme*	Published	Dr. A. J. Shinde, Dr. H. N. More	24/06/2022
19.	Artificial intelligence based approach along with nanoscale for accurate diagnosis and detection of skin cancer using biometric sensors	Published 202231054865	Dr. F. A. Tamboli	30/09/2022
20.	Integrating the techniques of computer vision along with machine learning algorithms to detect the disease of plant based on leaf structure	Published 202241054867	Dr. F. A. Tamboli	30/09/2022
21.	The Composition Of Polyherbal Soap For Skin	Published 202221051622 A	Dr. F. A. Tamboli	7/10/2022
22.	Green synthesized silver nanoparticles by using natural mucilage for anticancer potential	Published 202221058516 A	Dr. D. T. Gaikwad, Mr. R. R. Chavan	11/11/2022 13/10/2022
23.	Promising antidiabetic composition of *Terminalia arjuna*	Published 202221059364 A	Dr. D. T. Gaikwad, Mr. D. P. Mali, Mr. V. H. Thorat	11/11/2022 18/10/2022
24.	Polyherbal tablet composition for anti-inflammatory and immunomodulatory potential	Published 202221066689	Dr. D. T. Gaikwad	9/12/2022
25.	Transdermal ethosome composition of lanozoline	Published 202121023742	Dr. A. A. Hajare	May, 2021

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26.	Machine Learning Based Diagnosis of Chronic Kidney Disease In Diabetes Patients	Granted 2021107110	Dr. D. A. Bhagwat	Oct, 2021
27.	Artificial Intelligence Based Smart Touch Less Medicine Dispensing System For Pharma Field	Published 202141038793	Dr. D. A. Bhagwat	Aug, 2021
28.	Water Purifying and Flavor Infusion Devices	Published 347809-001	Dr. D. A. Bhagwat	Aug, 2021
29.	Machine Learning and Image Processing Based Smart Prediction of Human Emotions and Character	Published 202141035789	Dr. D. A. Bhagwat	Aug, 2021
30.	Microstrip Patch Antenna Based Detection of Breast Cancer using Microwave Breast Images Mishra	Published 202141035114	Dr. D. A. Bhagwat	Aug, 2021
31.	Eutectic mixture and process of preparing thereof	Published 202121023879	Dr. N. R. Jadhav, Mr. U. S. Patil	May, 2021
32.	Method for determining relationships between the properties of chemical compounds and biological activity	Published 202021026843	Dr. M. S. Bhatia	Nov. 2020
33.	Lyophilized myeloperoxidase from mammalian heart	Published 201921023861	Dr. Mrs. N. M. Bhatia, Dr. M. S. Bhatia	July 2019
34.	Myeloperoxidase bioassay kit	Published 201921023862	Dr. Mrs. N. M. Bhatia, Dr. M. S. Bhatia	July 2019
35.	Predictive computational model for selection of suitable grade of polymer for desired formulation property	Published 201921010545	Dr. M. S. Bhatia	Oct 2020
36.	Herbal Composition for Transdermal Delivery	Published 201721044914	Dr. D. T. Gaikwad, Dr. N. R. Jadhav	21-06-2019
37.	Co-amorphous Powder Composition for Dissolution Enhancement	Published 201821037948 A	Dr. D. T. Gaikwad, Mr. V. T. PawarMr. D. P. Mali	19/10/2018 08/10/2018

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Research Publications in Indexed Journals 2023

Sr. No	Title of Paper	Journal Name	Category
1.	Microwave assisted green synthesis, Single crystal XRD, DFT, Hirshfeld surface analysis, Antibiofilm, Anti-inflammatory activity and Molecular docking study of 4-(4-Fluorophenyl)-5-methyl-1,3-thiazole-2-amine	Journal of Molecular Structure	Drug Discovery Processes
2.	Synthesis, Characterization, ADMET-SAR Prediction, DPPH Assay, and Anti- Mycobacterium Study of 4-[(substituted benzyl) amino]benzo hydrazides and its Hydrazones as the Acyl-CoA carboxylase,AccD5 Inhibitors	Current Computer-AidedDrug Design	Drug Discovery Processes
3.	Exploration of limonoids for their broad spectrum antiviral potential via DFT, molecular docking and molecular dynamics simulation approach	Natural Product Research	Drug Discovery Processes
4.	Design of Multitarget Inhibitors as Tracheal Smooth Muscle Relaxants	Current Protein and Peptide Science	Drug Discovery Processes
5.	In silico evaluation of NO donor heterocyclic vasodilators as SARS-CoV-2 Mpro protein inhibitor	Journal of Biomolecular Structure and Dynamics	Drug Discovery Processes
6.	Computational Exploration of Anti-cancer Potential of Flavonoids against Cyclin- Dependent Kinase 8: An In Silico Molecular Docking and Dynamic Approach	ACS omega	Drug Discovery Processes
7.	Artificial Intelligence and Tools in Pharmaceuticals: An Overview	Research Journal of Pharmacy and Technology	Drug Discovery Processes
8.	Study of Robotic Surgeries in India: Economical Aspects and Applications inCancer Treatment	Research Journal of Pharmacy and Technology	Drug Discovery Processes
9.	Exploring biogenic chalcones as DprE1 inhibitors for antitubercular activity via in silico approach	Journal of Molecular Modeling	Drug Discovery Processes
10.	Exploration of bioactive molecules from Tinospora cordifolia and Actinidia deliciosa as an immunity modulator via molecular docking and molecular dynamics studies	Natural Product Research	Drug Discovery Processes

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11.	Molecular docking, QSAR, pharmacophore modeling, and dynamics studies of some chromone derivatives for the discovery of anti-breast cancer agents against hormone-dependent breast cancer	Journal of Biomolecular Structure and Dynamics	Drug Discovery Processes
12.	Fe3O4@ SiO2@ TDI@ DES: A novel magnetically separable catalyst for the synthesis of oxindoles	Journal of Molecular Structure	Drug Discovery Processes
13.	Identification of potential hits against fungal lysine deacetylase Rpd3 via molecular docking, molecular dynamics simulation, DFT, in-silico ADMET and drug-likeness assessment	Chemistry Africa	Drug Discovery Processes
14.	Synthesis, biological evaluation, and computational studies of 6-fluoro-3- (piperidin-4-yl)-1, 2-benzisoxazole sulfonamide conjugates	Polycyclic Aromatic Compounds	Drug Discovery Processes
15.	Exploring α, β-unsaturated carbonyl compounds against bacterial efflux pumps via computational approach	Journal of Biomolecular Structure and Dynamics	Drug Discovery Processes
16.	Identification of potential biogenic chalcones against antibiotic resistant efflux pump (AcrB) via computational study	Journal of Biomolecular Structure and Dynamics	Drug Discovery Processes
17.	A Systematic Review on Chemical Actives from Plant Sources, Targets and Chemotherapy for Triple-Negative Breast Cancer	Pharmaceutical Chemistry	Drug Discovery Processes
18.	Bioactive Natural Products for Breast Cancer Chemoprevention and Treatment	Current Bioactive Compounds	Drug Discovery Processes
19.	Ifosfamide-Loaded Cubosomes: An Approach to Potentiate Cytotoxicity against MDA-MB-231 Breast Cancer Cells	Fabad Journal of Pharmaceutical Sciences	Drug Delivery Applications
20.	Oral self- nanoemulsifying drug delivery systems for enhancing bioavailability and anticancer potential of fosfestrol: In vitro and In vivo characterization	European Journal of Pharmaceutics and Biopharmaceutics	Drug Delivery Applications
21.	Exploring anticancer potential of nintedanib conjugated magnetic nanoparticles: In-vitro and in-silico studies	Journal of Drug DeliveryScience and Technology	Drug Delivery Applications
22.	Design, development, and evaluation of docetaxel-loaded niosomes for the treatment of breast cancer	Future Journal of Pharmaceutical Sciences	Drug Delivery Applications

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23.	Physicochemical Evaluation and Standardization of Traditional Healing Herb Sonchus asper Linn	Research Journal of Pharmacy and Technology	Product Development
24.	Development of amino acid salt-based curcumin@ lysine acetate co-amorphous system using liquid-assisted grinding for improved solubility and dissolution	The Thai Journal of Pharmaceutical Sciences	Product Development
25.	Vacuum foam drying of docetaxel mixed micelles for improved stability and ovarian cancer treatment	Journal of Drug DeliveryScience and Technology	Product Development
26.	Development and validation of RP-HPLC method for quantification of sertraline in nanofiber formulation	Research Journal of Pharmacy and Technology	Product Development
27.	Preparation, statistical optimization, in-vitro evaluation and characterization of solid lipid nanoparticles of an anti-retroviral drug Nevirapine	Research Journal of Pharmacy and Technology	Product Development
28.	Nanophytosomes Loading Andrographispaniculata Hydroalcoholic Extract: Promising Drug Delivery for Hepatoprotective Efficacy	Journal of Pharmaceutical Innovation	Bioactivity assessment
29.	Remarkable anti-breast cancer activity and molecular docking studies of ferrocene tethered pyrimidobenzothiazoles and pyrimidobenzimidazoles	Results in Chemistry	Bioactivity assessment
30.	Evaluation of curcumin-loaded chitosan nanoparticles for wound healing activity	ADMET and DMPK	Bioactivity assessment
31.	Inflammatory Markers in Cord Blood for Early Diagnosis of Neonatal Sepsis	Research Journal of Pharmacy and Technology	Bioactivity assessment
32.	Morphological, Histological and Phytochemical Features of Nephrolepis cordifolia (L.) C. Presl	National Academy ScienceLetters	Bioactivity assessment
33.	Harnessing the Power of AI in Pharmacokinetics and Pharmacodynamics:A Comprehensive Review	International Journal of Pharmaceutical Quality Assurance	Bioactivity assessment
34.	Magnetic Resonance Imaging in Cerebral Venous Thrombosis	Research Journal of Pharmacy and Technology	Bioactivity assessment

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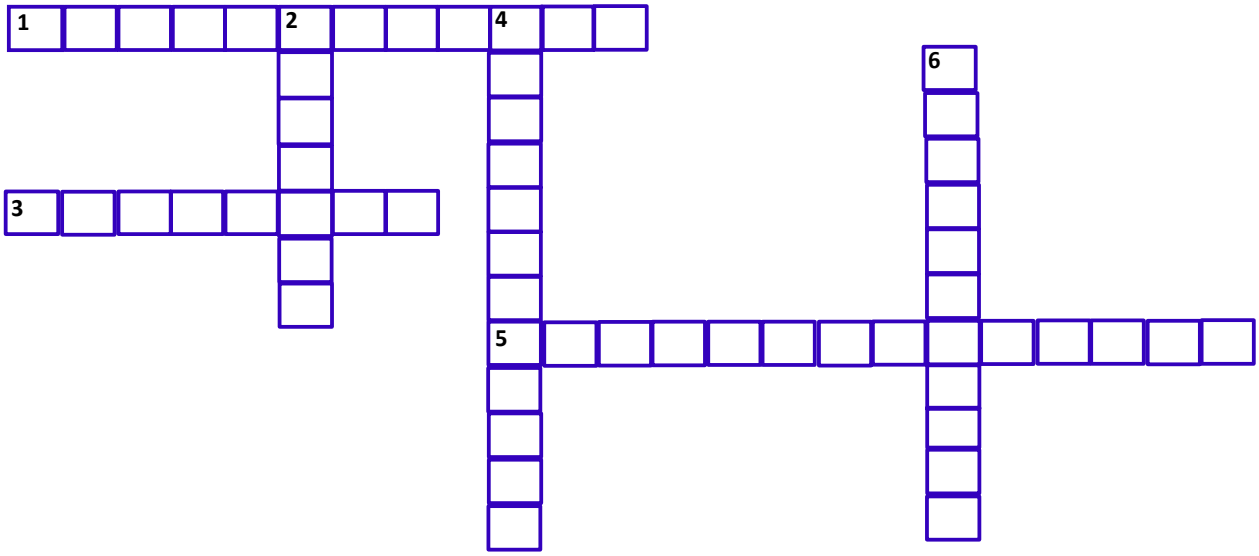
Mind Lab

Solve the Crossword and Sudoku Puzzles



Across

1. I am an anticancer drug also used for rheumatoid arthritis
3. I am a popular drink which was invented by a pharmacist
5. Food drug interaction of MAO inhibitors

Down

2. Congenital malformation causing intellectual disabilities
4. I can facilitate absorption of oral iron preparation
6. This drug will cause a risk blood dyscrasias

SUDOKU PUZZLE

5	3			7				
6			1	9	5			
	9	8					6	
8				6				3
4			8		3			1
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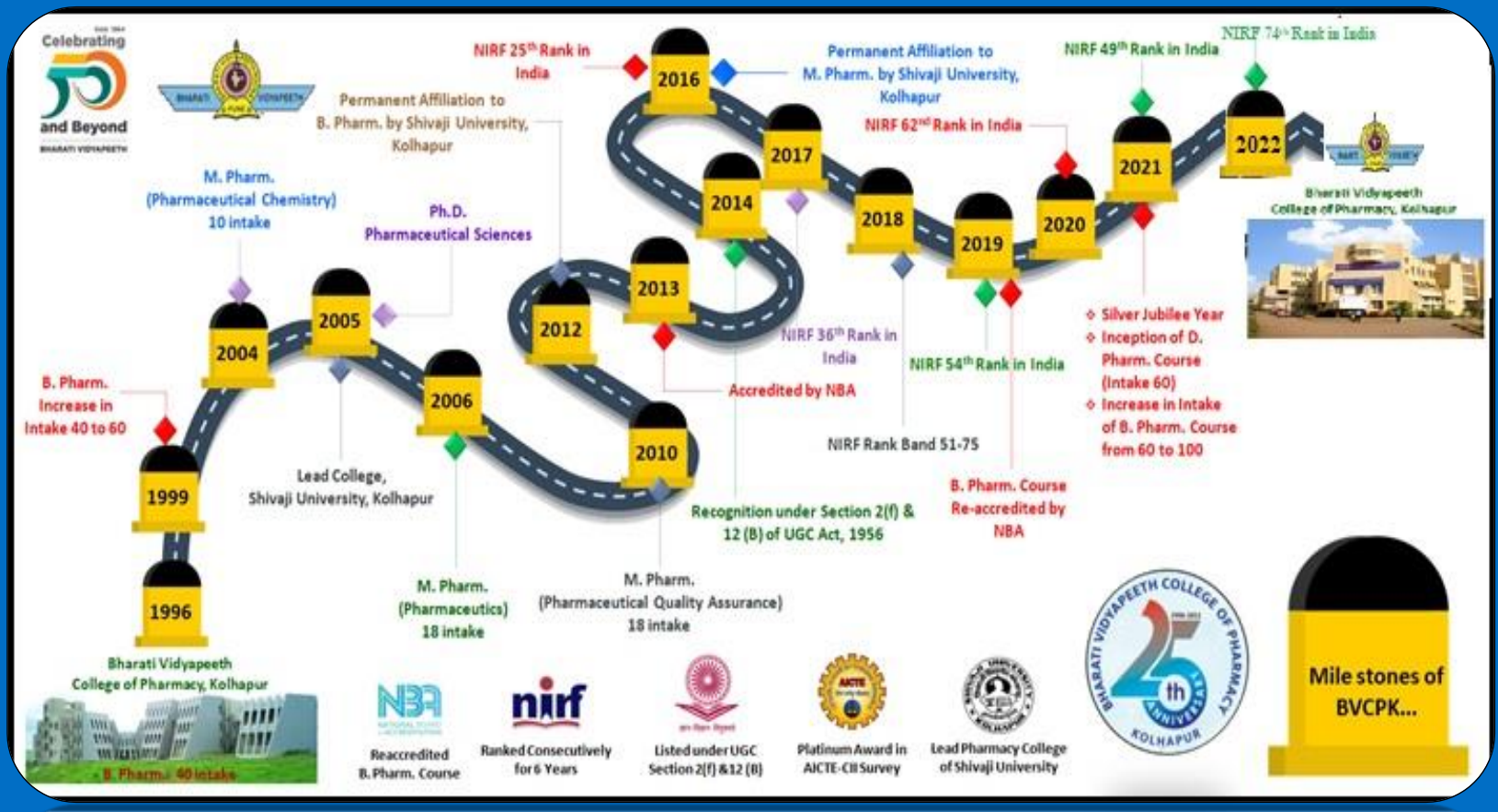

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