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A Nanotechnology-Green Synthesis of Nanoparticles for the Treatment of Alzheimer Disease

Anuja K U[1], Hemnath Elango[1], Jilsha G[1], Jayesh V N[2], Vineeth V S[2]

1. Faculty of Pharmacy, Karpagam Academy of Higher Education, Pollachi Main Road, Eachanari post, Coimbatore-641021
2. Department of Pharmaceutics, Triveni Institute of Pharmacy, Kecheri, Thrissur-680501

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ABSTRACT
Background: Alzheimer's disease (AD) is a progressive neurodegenerative disorder that is characterised by cognitive decline and memory loss. The exact cause of the disease is unknown; however, a combination of genetic, environmental, and lifestyle factors is believed to contribute to its onset.
Aim: Nanotechnology-Green Synthesis of Nanoparticles for the Treatment of Alzheimer Disease.
Methodology: The study examined the anti-Alzheimer's activity of various biogenically synthesized nanoparticles, focusing on their mechanisms, stability, and specific targeting attributes. Data was gathered from patent databases, conference abstracts, publications, and Google searches, concluding October 31, 2022.
Results: Genetic predisposition and family history of Alzheimer's increase risk, while environmental factors like toxins and head injuries can also heighten the risk. The disease is characterised by a deficiency in neurotransmitters, particularly acetylcholine, and the accumulation of abnormal proteins in the brain, such as beta-amyloid plaques and tau tangles, which disrupt communication between nerve cells and contribute to cognitive impairment .Chronic inflammation of the brain, vascular issues, and impaired energy metabolism in brain cells also contribute to disease complications. The emotional and economic burden of Alzheimer's is significant and there is an urgent need for effective interventions and support systems to alleviate its impact on individuals, caregivers, and society. Nanotechnology has emerged as a promising field, with diverse applications across various domains that contribute to human welfare. Nanoparticles have unique physical and chemical properties that make them invaluable for various applications, including the early detection of life-threatening disorders such as cancer, Alzheimer's disease, and bioremediation. The eco-friendly synthesis of metallic nanoparticles using green synthesis methods is a promising approach to avoid the generation of harmful byproducts.
Conclusion: AD is a neurodegenerative disorder influenced by genetics, environmental factors, and biology. Nanotechnology offers innovative treatments, including nanoparticles that address the blood-brain barrier, demonstrating its potential to revolutionize therapeutic approaches.

INTRODUCTION

Alzheimer's disease, a progressive neurodegenerative disorder characterised by cognitive decline and memory loss.The exact cause remains elusive, but a combination of genetic, environmental, and lifestyle factors are believed to contribute to its onset[1].Genetic predisposition is the primary cause. Individuals with a family history of Alzheimer's are at higher risk. Mutations in certain genes such as APOE have been identified as risk factors. These genetic variations can influence the accumulation of abnormal proteins in the brain, leading to the formation of plaques and tangles associated with Alzheimer's pathology. Environmental factors also play key roles. Chronic exposure to certain toxins or pollutants may increase the risk of AD development. Additionally, head injuries, especially those resulting in a loss of consciousness, have been linked to an elevated risk of the disease. Complications can arise from profound neurochemical changes in the brain [2].

Alzheimer's is characterised by a deficiency in neurotransmitters, particularly acetylcholine.This neurotransmitter is crucial for memory and learning, and its decline contributes to cognitive impairments.The hallmark of Alzheimer's disease is the accumulation of Aβ plaques and tau tangles in the brain.Beta-amyloid plaques disrupt communication between nerve cells, whereas tau tangles interfere with the internal support structure of the cells.These abnormalities lead to the death of brain cells, resulting in progressive cognitive decline in patients with AD.Another complication is chronic inflammation of the brain.The immune system's response to abnormal protein deposits contributes to ongoing inflammation, further damaging neurones[3].

This inflammatory process exacerbates cognitive decline and accelerates the disease progression.Vascular issues also contribute to the complications.Reduced blood flow to the brain, often caused by cardiovascular disease, can exacerbate cognitive decline.Conditions such as hypertension and atherosclerosis may increase the likelihood of developing Alzheimer's and worsen its symptoms.Patients with Alzheimer's disease often experience impaired energy metabolism in brain cells.Mitochondrial dysfunction, the energy-producing structure within cells, leads to decreased energy production.This energy deficit further impairs neuronal function and contributes to the cognitive decline[4].Complications extend beyond the biological realm and impact daily life.Patients with AD struggle with routine tasks, face challenges in communication, and may exhibit personality changes.The burden on caregivers increases as they witness a gradual loss of an individual's identity and abilities.The emotional toll is profound for both individuals with Alzheimer's disease and their loved ones.Patients may also experience anxiety, depression, or aggression. Caregivers often grapple with

feelings of helplessness and grief as they witness the gradual erosion of the person they once knew [5].
Alzheimer’s disease poses significant social and economic challenges.The increasing prevalence of the disease places strain on healthcare systems and caregivers.Economic burden includes medical expenses, long-term care, and lost productivity, highlighting the urgent need for effective interventions and support systems.AD is a complex and multifaceted condition, with various causes and complications.Genetic, environmental, and neurobiological factors contribute to its onset, which leads to a cascade of events that result in cognitive decline.Understanding these factors is crucial for developing targeted interventions and support systems to alleviate their impact on individuals, caregivers, and society.
Over the past two decades, nanotechnology has undergone remarkable advancements, emerging as a highly explored and rapidly growing field, with diverse applications across various domains contributing to human welfare.Nanoparticles, characterised by their minute size ranging from 1 to 100 nm, can either occur naturally or be artificially produced[6].Their unique physical and chemical properties, such as enhanced catalytic, magnetic, electrical, mechanical, optical, chemical, and biological capabilities, render them invaluable.Nanoparticles exhibit heightened reactivity, mobility, solubility, and strength owing to their impressive surface-to-volume ratios.To address environmental concerns, eco-friendly synthesis of metallic nanoparticles utilises green synthesis methods to avoid the generation of harmful byproducts[7].This approach involves the use of natural resources and efficient solvent systems to synthesise biogenic nanoparticles.
Plant extracts play a vital role in large-scale synthesis, leading to the production of biogenic nanoparticles.Nanotechnology holds great promise for the early detection of life-threatening disorders, such as cancer and Alzheimer’s disease.Nanoparticles have applications in bioremediation, effectively breaking down contaminants such as organic dyes and chemicals[8].The categorisation of nanoparticles is based on their chemical composition, including carbon-based, metal-oxide-based, bio-organic-based, and composite-based.In nature, nanoparticles can be organic or inorganic, with organic nanoparticles being biodegradable, whereas metallic nanoparticles, composed of inorganic materials, are commonly used for antibacterial, antifungal, and antiviral drugs.Synthesis of nanoparticles involves different approaches, including top-down and bottom-up methods.Furthermore, three distinct tactics, physical, chemical, and biological, have been employed in nanoparticle synthesis.This comprehensive understanding and utilisation of nanotechnology underscores its potential for transformative applications in various scientific and industrial fields[9].

METHODOLOGY

We conducted a systematic examination of the biogenic synthesis of nanoparticles and their anti-Alzheimer activity.This review focuses on mechanistic studies that explain the anti-Alzheimer activity of various biogenically synthesised nanoparticles.The report also provides a clear overview of key attributes, including stability and specific targeting, that contribute to the effectiveness of anti-Alzheimer’s activity.Our research encompasses patent databases, conference abstracts, publications, and news releases to gather information on eco-friendly synthesis and potential anti-Alzheimer activity. To supplement these sources, we also conducted PubMed searches for peer-reviewed journal articles and Google searches for grey literature, which ended on 31 October 2022 with strict adherence to the search methodology and selection criteria.

RESULTS AND DISCUSSION

Importance role of Nanoparticles in treatment of Alzheimer disease

The blood-brain barrier, a selectively permeable shield composed of microvascular endothelial cells, astrocytes, pericytes, neurones, and the basement membrane, controls the transport of substances to the brain by preventing paracellular diffusion, hydrophobic substance efflux, and regulating the active transport of nutrients.Additionally, it manages trans endothelial migration. When using nanoparticles for drug delivery to the brain, it is essential to overcome these mechanisms to achieve efficient brain accumulation. Nanoparticles use both active and passive transport mechanisms, influenced by factors such as size, charge, and surface modification[10]. Biogenic nanoparticles can serve as carriers for Alzheimer's disease drugs, improving their solubility, stability, and targeted delivery to cancer cells. Targeted drug delivery minimises the damage to healthy tissues and enhances the therapeutic efficacy of drugs.Nanoparticles play a crucial role in drug delivery owing to their unique properties and capabilities.

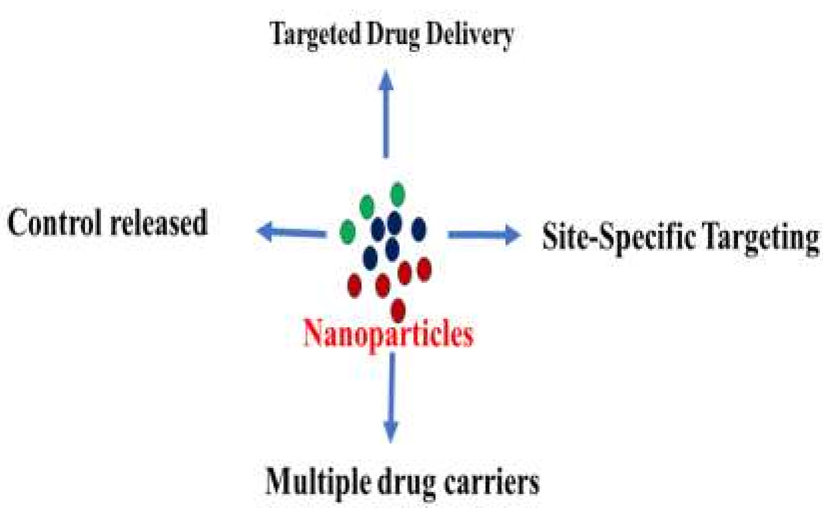

Figure 1: The significance of nanoparticles in Alzheimer's disease treatment

Targeted Drug Delivery-Alzheimer disease

Nanoparticles can be engineered to carry drugs to specific sites in the body, such as neuron tissues, through targeted delivery. This reduces damage to healthy cells and tissues, enhancing the therapeutic effect of the drug, while reducing its side effects. Targeted drug delivery using nanoparticles is a sophisticated method that aims to deliver therapeutic agents specifically to the site of action within the body. This strategy has several advantages over conventional drug delivery methods[11]. Nanoparticles can be designed to encapsulate drugs aimed at combating Alzheimer's disease pathology, and surface modifications can enhance their ability to cross the blood-brain barrier efficiently. Once in the brain, these nanoparticles can release encapsulated drugs in a controlled manner, ensuring a sustained and targeted therapeutic effect.Additionally, nanoparticles can be tailored to target specific biomarkers or pathological features associated with Alzheimer's disease, such as beta-amyloid plaques, minimising off-target effects, and enhancing the therapeutic impact of drugs[12].

Site-Specific Targeting-Alzheimer disease

The precision of nanoparticle-based drug delivery in Alzheimer's is remarkable. By engineering nanoparticles to target specific cells or tissues, we are essentially creating a guided missile for medication. Ligands such as antibodies or peptides act as homing devices and recognise and bind to receptors on target cells, ensuring that the drug hits its mark with accuracy[13].

This strategy leverages the enhanced permeability and retention effect, which is pronounced in certain pathological conditions, such as Alzheimer's disease.In areas with leaky blood vessels and compromised lymphatic drainage, nanoparticles selectively accumulate in the target tissues, offering a bullseye for drug delivery.This targeted approach not only enhances therapeutic efficacy, but also minimises exposure to healthy tissues, reducing the risk of side effects associated with systemic drug administration.

Nanoparticles also play a crucial role in intracellular drug delivery, which is a key consideration for drugs that target specific organelles or signalling pathways within cells.Their design allows for controlled drug release in response to environmental factors, such as pH, temperature, or enzymatic activity at the target site.This level of precision ensures a sustained therapeutic effect, optimising the treatment's impact on Alzheimer's disease while minimising adverse effects.It is like a tiny, intelligent courier system delivering medication exactly where it is needed[14].

Multiple drug carriers-Alzheimer disease

The versatility of nanoparticles in Alzheimer's treatment extends beyond single-drug delivery.These tiny carriers have a remarkable capability to simultaneously transport multiple drugs or therapeutic agents.This opens the door to combination therapy, in which different drugs, each with its unique way of tackling the disease, can be delivered together.This approach not only enhances efficacy, but also helps overcome potential drug resistance[15].Nanoparticles can be further improved by incorporating imaging agents into their cargo.This means that alongside therapeutic intervention, they can provide real-time diagnostic imaging.Imagine being able to monitor drug delivery and treatment responses as they occur.It is like a dynamic feedback system, allowing for adjustments and refinements in the treatment plan as needed.Its beauty lies in its customisation[16]. Targeted nanoparticles can be designed with specific characteristics tailored to an individual patient's disease. This personalised approach holds promise for developing more effective and precisely tailored treatment strategies.It is similar to having a tailor-made suit for Alzheimer's treatmentdesigned to fit the unique characteristics of each patient for optimal therapeutic impact.

Control released-Alzheimer disease

Nanoparticles bring a sophisticated solution to the table when it comes to drug delivery for Alzheimer's disease, especially considering the challenges posed by the limited water solubility of many drugs. These tiny carriers can encapsulate drugs with poor solubility, enhance their solubility, and improve their absorption in the body.The ability to orchestrate the controlled and sustained release of drugs is even more impressive[17].This extended-release profile not only reduces the frequency of drug administration but also promotes patient compliance by maintaining therapeutic drug levels over extended periods.It is like a smart, time-released capsule that ensures a steady supply of medication for optimal treatment.Additionally, nanoparticles act as guardians for drugs, shielding them from degradation, metabolism, and premature release in the body. This protective role ensures the stability and effectiveness of the drug until it reaches the intended target site, enhancing its overall impact on Alzheimer's disease.The small size of nanoparticles is not just a matter of scale; it is also a strategic advantage.Their compact dimensions enable efficient cellular uptake, which is a critical factor for drugs that need to reach specific intracellular targets.In essence, nanoparticles act as both bodyguards and escorts, ensuring that drugs reach their destination intact and at the right time, maximising the efficacy of Alzheimer's treatment[18].

Permeability Enhancement-Alzheimer disease

The enhanced permeability and penetration effect is like a secret weapon in the arsenal of nanoparticles for Alzheimer's treatment. These tiny marvels take advantage of leaky blood vessels in the brain and selectively accumulate at sites that require therapeutic intervention.It is a bit like having a GPS for drug delivery, guiding nanoparticles precisely where they are needed.However, this does not stop.Nanoparticles, which are multitaskers, can carry multiple therapeutic agents simultaneously[19].This opens the door to combination therapy, a powerful approach in Alzheimer's treatment, where different drugs can target various aspects of the disease simultaneously, potentially overcoming resistance.The versatility of nanoparticles is not limited to drug delivery; they also moonlight as contrast agents for imaging techniques. Imagine them as tiny beacons, aiding in the diagnosis and monitoring of Alzheimer's and other diseases. Furthermore, these nanoparticles can be engineered to respond to specific stimuli, acting as sentinels that detect physiological changes in the body.Nanoparticles are becoming revolutionary tools for drug delivery owing to their adaptability and fine-tuning capabilities.They offer solutions to challenges associated with conventional drug administration, providing hope for more effective and precise therapeutic approaches not only in Alzheimer's disease, but also in various medical fields[20].Ongoing research in nanotechnology is like unlocking the full potential of a superhero; there is always more to discover and utilise for the greater good of healthcare.

Different types of nanoparticles and its important role in the treatment of Alzheimer disease

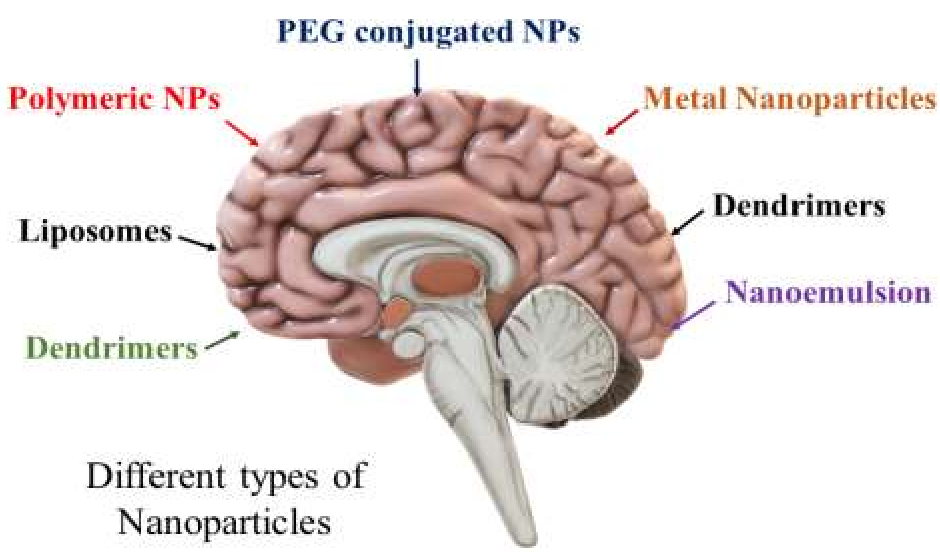

Figure 1: Different types of nanoparticles and its important role in the treatment of Alzheimer disease

PEG conjugated NPs

Polyethylene glycol (PEG)-conjugated nanoparticles represent a cutting-edge strategy in the treatment of Alzheimer's disease.The conjugation of PEG to nanoparticles serves several crucial purposes for enhancing the efficacy of drug delivery.PEGylation improved the biocompatibility of nanoparticles[21].It forms a protective layer around nanoparticles, reducing their recognition and clearance by the body's immune system.This stealthy disguise allows the nanoparticles to circulate in the bloodstream for an extended period, increasing the chances of reaching their intended destination within the brain.PEGylation enhanced the stability of nanoparticles.This shields them from premature drug release, degradation, and interactions with biological components.This stability is crucial for maintaining the integrity and effectiveness of drugs until they reach the targeted regions in the brain affected by Alzheimer's disease.PEG-conjugated nanoparticles improve the overall pharmacokinetics of drug delivery systems.They can navigate the complex and selective barriers of the blood-brain barrier more effectively, ensuring that a higher concentration of therapeutic agents reaches the brain. This is particularly important in Alzheimer's, where precise and targeted drug delivery to the brain is essential for optimal treatment[22].PEG conjugation to nanoparticles in Alzheimer's treatment is like giving these carriers sophisticated disguise and armor.It allows them to stealthily navigate the body, maintain stability, and enhance drug delivery to the brain, ultimately improving the prospects of effective therapeutic interventions for Alzheimer's disease.

Polymeric nanoparticles

Polymeric nanoparticles are emerging as a cutting-edge solution for the treatment of Alzheimer's disease.Crafted from biocompatible and biodegradable polymers, these nanoparticles are versatile and show great promise. Their tunable characteristics allow for meticulous customisation, addressing the intricate challenges presented by the blood-brain barrier.The biodegradable nature of these nanoparticles ensures the breakdown of materials into non-toxic byproducts, minimising potential long-term side effects, which is a crucial consideration for chronic conditions, such as Alzheimer's disease[23].As adept couriers, polymeric nanoparticles encapsulate a diverse range of drugs, shielding them from degradation, and orchestrating controlled release, which is vital for maintaining therapeutic drug levels over time.Moreover, their responsive design, which is triggered by specific stimuli, enhances the precision and efficiency of drug delivery[24].As research in this field progresses, polymeric nanoparticles are poised to revolutionise drug delivery and treatment strategies, offering a tailored and dynamic approach to combat Alzheimer's disease.

Liposomes

Liposomes, which are lipid-based vesicles with a unique structure resembling cell membrane, have emerged as a promising avenue for the treatment of Alzheimer's disease. These microscopic spheres can encapsulate a variety of therapeutic agents, including drugs designed to combat Alzheimer's pathology. Their phospholipid bilayer structure allows both hydrophobic and hydrophilic drug encapsulation, accommodating a wide range of therapeutic compounds.One of the key advantages of liposomes in Alzheimer's disease treatment is their ability to traverse the blood-brain barrier effectively.This barrier poses a significant challenge for drug delivery to the brain; however, liposomes can exploit various strategies, such as surface modifications, to enhance their permeability and ensure targeted drug delivery[25].Liposomes also offer a controlled-release mechanism, allowing sustained and prolonged drug delivery.This is particularly advantageous in Alzheimer's disease, where maintaining consistent therapeutic drug levels over time is crucial for effective treatment. The biocompatibility and biodegradability of liposomes contribute to their safety profile. As carriers, liposomes can reduce the toxicity of certain drugs and minimise their side effects, which is a crucial consideration for Alzheimer's patients who may require long-term treatment.Liposomes are versatile and efficient drug delivery vehicles for Alzheimer's disease[26].Their unique properties make them well suited for navigating the challenges of the brain environment, providing hope for more effective and targeted therapeutic interventions in the ongoing battle against Alzheimer's disease.

Dendrimers

Dendrimers, which are highly branched and well-defined macromolecules, are emerging as promising frontiers for the treatment of Alzheimer's disease.These three-dimensional structures offer unique advantages in drug delivery because of their precise architecture, providing a controlled and tailored approach for therapeutic intervention.The multivalent nature of dendrimers allows the attachment of multiple drug molecules, enabling a synergistic combination of therapeutic agents. This is particularly advantageous in Alzheimer's treatment, where a multifaceted approach may be essential to address the complex pathology of the disease[27].Dendrimers can also be engineered to cross the blood-brain barrier efficiently, facilitating targeted drug delivery to the brain, which is a critical factor in Alzheimer's treatment.Their size, surface charge, and functional groups can be finely tuned to optimise their transport across this barrier.Furthermore, dendrimers offer a controlled-release mechanism, allowing sustained and prolonged drug delivery. This is crucial in Alzheimer's, where maintaining consistent therapeutic drug levels over time is essential for efficacy.The versatile nature of dendrimers extends their ability to encapsulate various types of drugs including small molecules and biomolecules.This adaptability allows for customised and multifunctional drug delivery platforms. Dendrimers hold great promise as sophisticated vehicles for Alzheimer's treatment[28]. Their precision in drug delivery, ability to cross the blood-brain barrier, and versatility in accommodating diverse therapeutic agents make them compelling candidates in the ongoing pursuit of effective strategies against Alzheimer's disease.

Metal Nanoparticles

Metal nanoparticles have sparked significant interest in the realm of Alzheimer's disease treatment, showing unique properties that offer innovative solutions.Among these, gold and silver NPs are particularly noteworthy for their potential therapeutic applications.Gold nanoparticles, with their biocompatibility and ability to be functionalized, hold promise for drug delivery in Alzheimer's disease treatment.They can be tailored to encapsulate drugs and efficiently navigate the blood-brain barrier, ensuring targeted delivery to affected areas.Additionally, gold nanoparticles exhibit plasmonic properties that can be exploited for imaging and diagnostic purposes, aiding the precise monitoring of therapeutic interventions.AgNPs, known for their antimicrobial properties, can play a role in addressing neuroinflammation, a significant aspect of Alzheimer's pathology[29].Their anti-inflammatory effects may contribute to alleviating the immune response in the brain, potentially slowing disease progression.Metal nanoparticles can be engineered for multifunctionality by incorporating therapeutic agents alongside imaging or diagnostic components.This versatility allows for a comprehensive approach for both the treatment and monitoring of Alzheimer's disease.While the application of metal nanoparticles in Alzheimer's treatment is an exciting area of research, challenges such as biocompatibility and potential toxicity require careful consideration.Ongoing studies aim to harness the unique attributes of metal nanoparticles to develop safe and effective strategies for combatting Alzheimer's disease, offering a glimpse into the future of innovative therapeutic interventions.

Dendrimers

Dendrimers, which are intricate and highly branched macromolecules, present a promising frontier in the pursuit of effective Alzheimer's disease treatment.Their precisely defined architecture allows for a controlled and targeted approach to drug delivery, making them standout contenders in the complex landscape of neurodegenerative disorders.One notable advantage lies in the multivalent nature of dendrimers, which enables the attachment of multiple drug molecules. This characteristic is particularly valuable in Alzheimer's treatment, where a combination of therapeutic agents may be necessary to address the multifaceted aspects of the disease.Dendrimers can be engineered to efficiently traverse the blood-brain barrier, which is a critical hurdle in drug delivery to the brain.Their tunable size, surface charge, and functional groups can be optimised to enhance penetration, ensuring targeted delivery of therapeutic payloads to affected regions.A controlled release mechanism further distinguished the dendrimers.This capability allows for sustained and prolonged drug delivery, a crucial factor in AD, where maintaining consistent therapeutic drug levels over time is essential for optimal treatment.The adaptability of dendrimers extends their ability to encapsulate various types of drugs, from small molecules to biomolecules.This flexibility allows for a tailored and multifunctional drug delivery platform that addresses the diverse challenges posed by Alzheimer's pathology.In essence, dendrimers offer a sophisticated and precise tool for the treatment of AD.Their ability to deliver a combination of therapeutic agents, navigate the blood-brain barrier, and provide controlled release makes them promising candidates for the development of innovative and effective treatment strategies.

Nanoemulsion

Nanoemulsions, characterised by their fine droplet size and stability, are emerging as promising avenues for the treatment of Alzheimer's disease.These colloidal systems, which are typically composed of oil, water, and emulsifying agents, offer unique advantages for drug delivery and therapeutic interventions.One key strength of nanoemulsions is their ability to encapsulate both hydrophobic and hydrophilic drugs. This versatility allows for the efficient delivery of a diverse range of therapeutic agents, catering to the complex nature of Alzheimer's pathology.The small droplet size of nanoemulsions enhances their bioavailability, facilitating better absorption and distribution of drugs in the body. This is particularly crucial for Alzheimer's treatment, where targeted drug delivery to the brain is challenging because of the blood-brain barrier. Nanoemulsions can be designed for controlled and sustained drug release to optimise the therapeutic efficacy over time. The tunable properties of these emulsions, such as droplet size and surface charge, enable customisation to suit specific drug release requirements and ensure a steady and prolonged supply of medication[30].The stability of nanoemulsions makes them well suited for incorporating imaging agents, facilitating simultaneous diagnostic imaging and therapeutic interventions.This dual functionality enhances the monitoring and assessment of AD treatment outcomes.While research on nanoemulsion-based Alzheimer's treatment is ongoing, their potential to overcome barriers such as the blood-brain barrier[31], provide controlled drug release, and offer a versatile platform for drug delivery makes them promising candidates for effective therapeutic strategies against Alzheimer's disease[32].

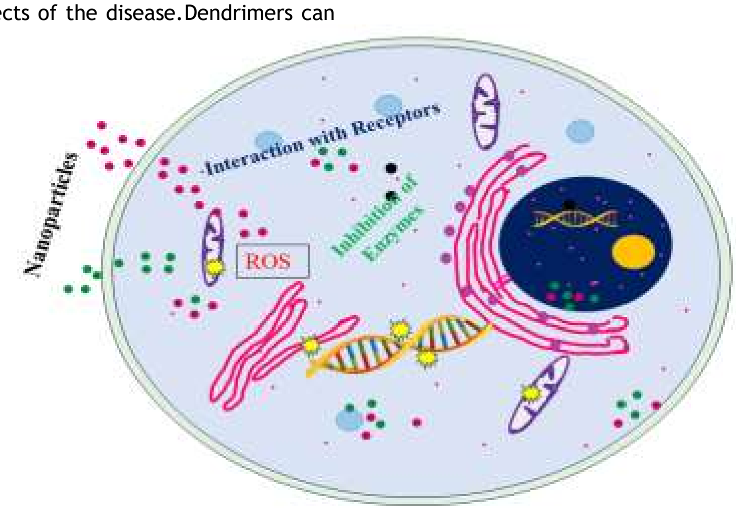

Figure 3: Nanoparticles and its Alzheimer activity

CONCLUSION

AD, a complex neurodegenerative disorder, poses significant challenges for both understanding and treatment.A combination of genetic, environmental, and neurobiological factors contributes to its onset, leading to a cascade of events that result in cognitive decline.The complications range from neurotransmitter deficiencies to the accumulation of abnormal proteins, chronic inflammation, vascular issues, and energy metabolism disruptions.The impact extends beyond the biological realm, affecting daily life, caregivers, and presenting significant social and economic challenges.Amidst these challenges, nanotechnology has emerged as a beacon of hope, offering innovative solutions for Alzheimer's treatment. Nanoparticles play a pivotal role in drug delivery, addressing the intricacies of the blood-brain barrier and enhancing the precision of therapeutic interventions. From targeted drug delivery to controlled release, the versatility of nanoparticles allows for a tailored and multifunctional approach to Alzheimer's treatment. Various types of nanoparticles, including PEG-conjugated NPs, polymeric NPs, liposomes, and metal NPs, have unique attributes that contribute to their effectiveness in combatting Alzheimer’s disease.PEG-conjugated nanoparticles, with their stealthy disguise and armor, improve biocompatibility, stability, and overall pharmacokinetics, thereby enhancing targeted drug delivery. Polymeric nanoparticles, characterized by biodegradability and customization, provide a versatile solution in navigating the challenges of the blood-brain barrier. Liposomes, which mimic cell membranes, offer a controlled-release mechanism and effective drug delivery to the brain.Metal nanoparticles, particularly gold and silver, have unique properties for imaging and therapeutic applications.Dendrimers, with their precise architecture and multifunctionality, present a sophisticated tool for Alzheimer's treatment, addressing the multifaceted nature of the disease. Nanoemulsions, characterised by fine droplet size, offer a promising avenue for drug delivery, overcoming barriers such as the blood-brain barrier and providing controlled drug release.In the quest for effective Alzheimer's treatment, nanotechnology stands at the forefront, offering transformative possibilities.Ongoing research and development in this field underscores its potential to revolutionise therapeutic approaches, providing hope for improved outcomes for individuals, caregivers, and society at large.

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Abbreviation
AD: Alzheimer disease
NPs: Nanoparticles
PEG: Polyethylene glycan
AgNPs: Silver Nanoparticles

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