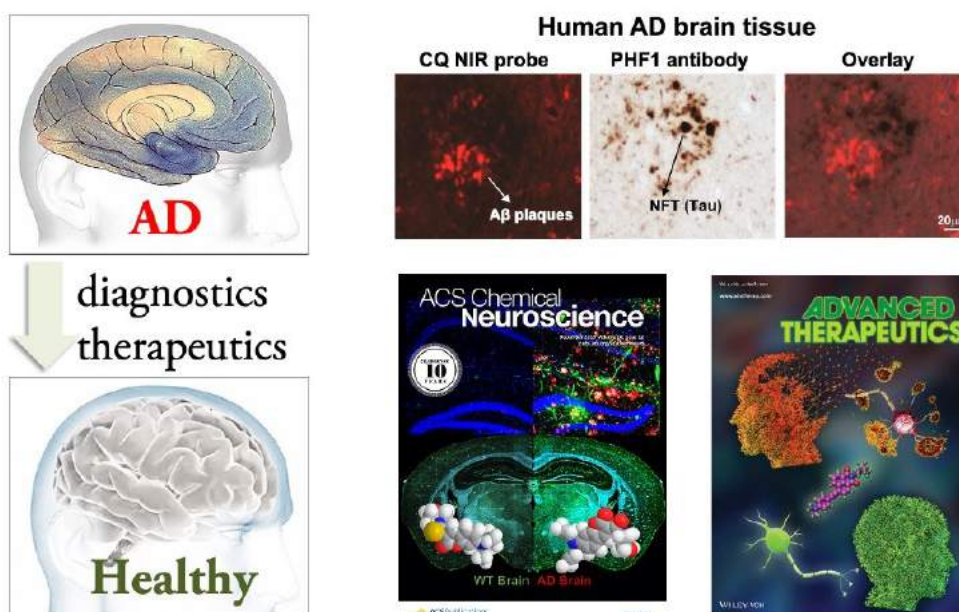


## Detailed Research work

Govindaraju's research is focussed on the theme of 'functional and disease amyloids' which encompasses the interface of chemistry, biology and biomaterials science. With expertise in organic synthesis, peptide chemistry, bioconjugate chemistry, biophysical techniques and chemical biology, he has been engaged in solving two classes challenging problems related to human health and society.

**A. Tackling Alzheimer's disease (Diagnostics and Therapeutics).** AD is a multifactorial disease with multiple biomarkers and disease targets (Book 2021). Current efforts in academia and industries are directed at individual targets to develop diagnosis and treatment for AD and hence have met continuously with failures. Govindaraju's laboratory is pursuing multipronged strategies to target multiple biomarkers and disease targets



(proteins aggregation, circulating and genetic biomarkers, aberrant PTMs, malfunctioning of clearance mechanisms, reactive oxygen species, biomolecules and mitochondrial damage, and oxidative stress, neuroinflammation and microglia, membrane toxicity, and synopsis toxicity among others that contribute significantly to disease pathogenesis) to develop reliable diagnosis and therapeutics for AD.\* His group is studying the relationship of AD with cancer and diabetes (ACS Appl. Bio Mater. 2020, Theranostics 2020). Their work in the inverse relationship between AD and cancer resulted in the discovery of a potential

theranostic (diagnostic therapy) drug candidate for lung cancer, one of the difficult cancer types to be diagnosed and treated (Theranostics 2020).

(\*Publications: Adv. Therap. 2021, ChemComm 2015; ChemBioChem 2020, Bull. Chem. Soc. Jpn. 2020, Org. Biomol. Chem. 2018, Org. Biomol. Chem. 2013, Org. Biomol. Chem. 2021, ACS Chem. Neurosci. 2016, 2018, 2019, 2020, iScience 2020, Biosens. Bioelectron. 2017, Chem. Sci. 2016, Nucleic Acid Res. 2015, US Patent 10,745,393, US Patent 10683273, US Patent 10,544,167).

- His laboratory has established molecular tools and protocols for differential detection and diagnosis of AD over tauopathies and other neurodegenerative diseases (validated in *ex vivo* AD human samples and *in vivo* AD mouse model). This, first of its kind protocol, allows differential detection of AD and can serve as a valuable tool for diagnosis of AD in case of mixed dementia (Biosens. Bioelectron. 2017, US Patent 10,745,393). To translate this invention, Govindaraju founded a startup (VNIR Biotechnologies Pvt. Ltd) to develop NIR fluorescence and positron emission tomography (PET)-based diagnosis platform for early diagnosis of AD.
- His group validated a novel combination-biomarker (ACS Chem. Neurosci. 2019) for reliable diagnosis of AD, which is qualified to be added to designated list of biomarkers by National Institute on Aging and Alzheimer's Association (NIA-AA) research framework 2018 for AD diagnosis. The research methodology and approach from his laboratory also laid the foundation for multiplexed and multimodal detection and imaging of core and indirect biomarkers, this generates characteristic fingerprint profiles to clearly distinguish AD patients from the healthy individuals (Bull. Chem. Soc. Jpn. 2020, ACS Chem. Neurosci. 2019, Chem Sci. 2016, Org. Lett. 2012, Chem. Eur. J. 2011, 2012, Org. Biomol. Chem. 2013). This unique biomarker together with NIR molecular tool (*vide supra*) has the potential to deliver reliable and early diagnosis of AD. The translation of these inventions is taken up through his startup, VNIR Biotechnologies.
- In his laboratory, multifunctional therapeutic candidates were developed to ameliorate multifaceted toxicity of AD.\* A novel drug candidate molecule (TGR63) was discovered and found to be effective in notable reduction of amyloid burden in the AD brain and reverse cognitive decline in animal models of early, MCI (mild cognitive decline) and advanced stages of AD (Adv. Therap. 2021, Indian patent and PCT application filed). This candidate is taken up for clinical studies by a pharmaceutical company with

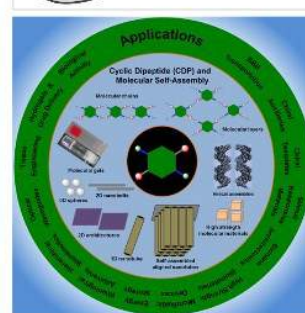
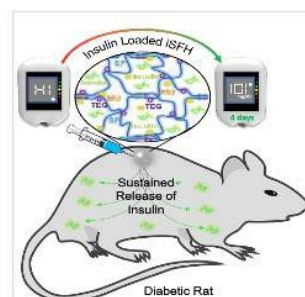
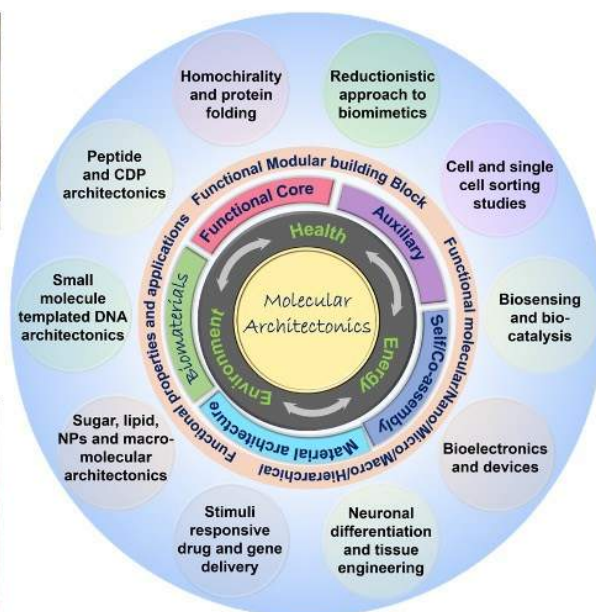
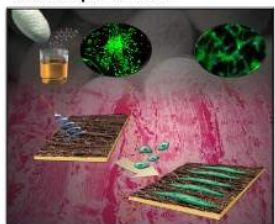
promise to treat AD in humans. (\*ChemComm. 2015; ChemBioChem 2020, BCSJ 2020, Org. Biomol. Chem. 2018, ACS Chem. Neurosci. 2016, 2018, 2019, 2020, iScience 2020)

- Several molecular tools established in his laboratory find utility in developing prognosis/diagnosis protocols, devices, and effective drug candidates for diseases including AD, malaria, kidney disease and cancer. Many of these inventions are being commercialized through his startup (VNIR Biotechnologies) or have been licensed to develop bioimaging, point-of-care diagnostics and other applications (Biosens. Bioelectron. 2017, Chem. Sci. 2016, Nucleic Acid Res. 2015, Org. Biomol. Chem. 2021, Chem. Soc. Rev. 2018, US Patent 10,745,393, US Patent 10683273, US Patent 10,544,167, US Patent 10,745,393, US Patent 8642764). Some of the molecular tools developed in his laboratory have the potential to be developed into theranostic drugs (diagnostic therapy) with profound implications for personalized medicine (Theranostics 2020, Indian patent and PCT applications filed, Nucleic Acid Res. 2015, US Patent 10683273).
- His lab is presently involved in the studies of fundamental relationship between AD, cancer and diabetes. This work on the inverse relationship between cancer and AD resulted in discovery of the first small molecule-based theranostic (diagnosis and treatment) drug candidate for lung cancer (Theranostics 2020), one of the difficult cancer types to be diagnosed and treated.

**Molecular architectonics**, a state-of-the-art innovation and new research theme has emerged from his group\* to integrate the realms of molecules, nano and microscale



Biomaterials  
Tissue Engineering  
Neurodegeneration  
Drug delivery  
Therapeutics



architectures into functional applications in bioelectronics, homochirality, chirality switching, reductionistic systems to understand protein folding, high-strength biomaterials, self-cleaning, biosensors, biomimetic catalysis, Fluorescent organic nanoclusters, drug delivery, wound-healing, stem cells to neuronal differentiation, and tissue engineering.\*\* Inspired by functional amyloids, the scheme of molecular architectonics is conceived as the reductionist molecular strategy to design and develop functional biomimetic architectures. Amino acids, peptides, nucleobases, sugars and lipids with built-in information needed for molecular recognition in the form of minute structural-mutations and chirality serve as the functional components in the scheme of molecular architectonics.

- The scheme of molecular architectonics has aided the development of devices for ultrasensitive detection of neurotoxic organic and inorganic mercury in water and biofluids with highest sensitivity (attomolar,  $60 \times 10^{-18}$  M or 0.01 parts per quadrillion, ppq) and selectivity ever reported (Biosens. Bioelectron. 2018, ACS Appl. Mater. Interfaces 2016). These tools and devices are useful in monitoring water quality and human health from mercury toxicity.
- Silk protein-based formulations have been specially developed for sustained (4 days) and controlled in vivo insulin delivery (ACS Appl. Bio Mater. 2020). This invention is very valuable considering the alarming rise in global diabetes cases particularly in India and is being translated for societal use.
- Silk and melanin-based hybrid scaffolds have been fabricated to aid the diabetic-wound healing, skeletal muscle and neuronal (stem cells-based) tissue engineering which is being considered a complementary approach to treat neuronal loss in AD (Adv. Healthcare Mater. 2016, ACS Appl. Mater. Interface, 2016, Biomaterials 2020). The silk-based inventions and products developed in his laboratory are considered a great value addition to sericulture industry and farmers.
- His group is at the forefront of upcycling cyclic dipeptide (CDP) for design and production of synthetic silk mimics, which paves the way for required structural and functional modifications to cater to diverse biomedical applications from drug delivery to tissue engineering (ChemPlusChem 2017, Org. Biomol. Chem, 2017, Chem Eur. J.

2013, Eur. J. Org. Chem. 2017, Biomacromolecules 2017, ACS Appl. Bio Mater. 2020, J. Org. Chem. 2019).

- The scheme of molecular architectonics guided the conceptualization of templated DNA nanotechnology (functional DNA nanoarchitectonics) to overcome the limitations of classical DNA nanotechnology in practical applications like biosensors and drug delivery systems (Book 2019, ChemComm 2015, ChemComm 2016, Beilstein J. Nanotechnol. 2020, ChemBioChem 2016, 7, 2162, ACS Appl. Bio Mater. 2020).

(Publications: \*Acc. Chem. Res. 2018, Bull. Chem. Soc. Jpn. 2019, Chem. Asian J. 2021, Beilstein J. Nanotechnol. 2020, Adv. Mater. Interfaces 2020, Adv. Mater. 2012, Nanoscale 2012, 2014, Book 2019, Book 2021.; \*\*Adv. Funct. Mater. 2011, ACS Appl. Mater. Interfaces 2016, ChemComm 2015, Chem. Eur. J. 2012, Chem. Eur. J. 2013; ACS Appl. Mater. Interfaces 2015, J. Phys. Chem. Lett. 2013, Sci. Rep. 2015, Angew. Chem. Int. Ed. 2012, Biosens. Bioelectron. 2018, ACS Appl. Mater. Interfaces 2016, ChemComm 2018, J. Org. Chem. 2019, ACS Appl. Mater. Interface, 2020, J. Am. Chem. Soc., 2016, ACS Appl. Nano Mater. 2021, ACS Appl. Bio Mater. 2020, 2020, 2020, Org. Biomol. Chem, 2017, ACS Appl. Mater. Interface, 2016, Biomaterials 2020, Adv. Healthcare Mater. 2016)

To sum up, novel concepts and research themes in basic and applied chemistry have emerged from his laboratory with translational value to solve problems related to human health and directly impact society.

## Technology Developed, Transferred and Entrepreneurship

I. Govindaraju co-founded a startup VNIR Biotechnologies Pvt. Ltd. in 2017 to translate many of his laboratory inventions (patents) into commercial products.

He is the chief brain in **VNIR Biotechnologies Pvt. Ltd.** and the novel red-NIR molecular tools-based solutions and products have been developed for bioimaging (academic and disease research) and devices/kits used in point-of-care and clinical care diagnostics. At VNIR, one of the major goals is to develop NIR and PET-based multiplexed and multimodal diagnostic kit (to investigate the brain, retina and biofluid) for Alzheimer's disease.

**VNIR Biotechnologies Pvt. Ltd.**  
Bangalore Bioinnovation Centre  
Helix Biotech Park, Electronic City,  
Bengaluru.

<http://www.vnir.life>



VNIR Biotechnologies Pvt. Ltd. was awarded E<sup>L</sup>VATE 100 Start Up company in 2018 by Govt. of Karnataka. VNIR is a unique company in India with global outreach and aligned with Self-reliance and Atmanirbhar Bharat initiatives of Govt. of India. VNIR has established capabilities to indigenously design and manufacture molecular probes for bioimaging and diagnostic applications.

Covered in

[India's science start-ups](#), **Chemistry World**, Royal Society of Chemistry (**RSC**) (Nov 11, 2017)

[Science-based entrepreneurs are just starting-up](#), **Deccan Herald** (Dec 21, 2017)

[On the path to developing technically superior molecular probes](#), **Chemical Today** (January 04, 2021)

### Contribution to COVID19 Detection kit

VNIR has indigenously developed molecular probes, one of the three components in the kit, and PCR mix required for COVID19 detection kit (2020).

COVID19 products of VNIR were launched in July 2020 by Dr. C. N. Ashwath Narayan, Deputy Chief Minister, Govt. of Karnataka



[JNCASR spinoff launched molecular probes used in COVID-19 test kits](#)

[Dy CM Ashwathnarayan Launches 6 Locally- Made Products to Tackle COVID-19 In Karnataka](#)

[Karnataka start-ups launch six indigenous products to tackle Covid-19](#)

[DST start-up comes up with indigenous probes used in RT-PCR tests](#)

[JNCASR spinoff launched molecular probes used in COVID-19 test kits](#)

[Startups tweak their products for coronavirus use](#)

## II. TECHNOLOGY TRANSFER AND PRODUCT DEVELOPMENT

Govindaraju has licensed inventions for developing point-of-care diagnostic kits and therapeutics, and undertaken product development through approved translational projects.

- Julolidine conjugates and methods for their preparation and use. US patent No. 8642764. Transferred to Intellectual Ventures (IV)
- Radical Scavenging antioxidant cyclic dipeptides and silk fibroin biomaterials (patent filed). Joint development agreement signed; technology has been shared with L'OREAL INDIA PRIVATE LIMITED.
- K. Rajasekhar (Int. Ph.D. student) work on "Near Infrared Fluorescence Probes for Diagnosis of Alzheimer's Disease" has been awarded with "**Gandhian Young Technological Innovation Award (GYTI 2017)**" and project for translation of the invention. and received the award at function organized at Rashtrapati Bhavan, New Delhi" and received funding for translation by **BIRAC-SRISTI**.
- M. B. Avinash's (Ph.D. student,) work on "Self-cleaning functional molecular material" has been appreciated with "**Gandhian Young Technological Innovation Award**" under



"SRISTI Technological Edge/Strategic Innovation" category at Indian Institute of Management - Ahmedabad (IIM-A). This work was highlighted in newspaper *Bangalore Mirror* as "A self-cleaning surface that makes housework a cakewalk".

### III. ALZHEIMER'S THERAPEUTICS

**A novel drug candidate (TGR63) discovered for the treatment of Alzheimer's disease. The efficacy of TGR63 is demonstrated in AD animal model which reverse cognitive decline.**

**This drug candidate is taken up for clinical studies by a pharmaceutical company.**

**This invention was highlighted by Kiran Mazumdar-Shaw (February 25 2021)**



**Kiran Mazumdar-Shaw** @kiranshaw · Feb 25  
Scientists @jncasr have developed a molecule that disrupts the mechanism through which neurons become dysfunctional due to Alzheimer's. Can be a potential drug candidate to treat Alzheimer's disease.



**JNCASR develops molecule that may help treat Alzheimer's**  
First identified over a 100 years ago, Alzheimer's disease has no major medication till date that can assist in permanent treatment.

**Highlighted in major newspapers and media/TVs**

### THE HINDU (March 2021)

#### JNCASR team develops potential drug candidate for Alzheimer's

The team observed that the small molecule TGR63 reduced amyloid plaques in mice brains and reversed cognitive decline



**Alzheimer's breakthrough**  
The World Alzheimer Report 2020 states that an estimated 50 million people worldwide are living with dementia. The number is expected to rise to 75 million by 2030.

**Researcher's discovery**  
The team observed that the small molecule TGR63 reduced amyloid plaques in mice brains and reversed cognitive decline.

**Impact on mice**  
Mice are often used as models to study Alzheimer's disease.

## New molecule could be potential drug candidate to halt or cure Alzheimer's

Scientists From JNCASR Prepare For Clinical Trials

Chetana.Kanwar@timesgroup.com

Bengaluru: After more than 10 years of research, scientists from Jawaharlal Nehru Centre for Advanced Scientific Research have developed a small molecule that can prevent the mechanism resulting in neurons (brain cells) becoming dysfunctional in Alzheimer's disease (AD).



date to halt or cure the leading cause of dementia. "We are preparing for clinical trials and are looking to partner with pharma firms both in India and outside," Govindaraju told TOI.

Saying that in the Alzheimer's brain, abnormal levels of naturally forming proteins clump together to form plaques that collect between neurons and disrupt cell function, Govindaraju said this is caused by production and deposition of a protein called amyloid peptide that accumulates in the central nervous system.

The multifactorial nature of AD, attributed to multifaceted amyloid toxicity, has kept re-

searchers from developing effective treatment. Now, we have designed and synthesised a set of novel small molecules and identified a lead candidate which could reduce amyloid peptide toxicity," he explained. He said detailed studies have established TGR63 to rescue neuronal cells from amyloid toxicity. Remarkably, he said, the molecule was also found to reduce amyloid burden in the cortex and hippocampus, or a complex part embedded deep into the temporal lobe, thereby reversing cognitive decline. This research was recently published in the journal Advanced Therapeutics.

"Any treatment relating to the brain has a major challenge in breaking the blood-brain barrier which prevents drugs from reaching the brain. In this case, it manages to break this and reach the brain," he said. Govindaraju added that no approved drugs that address disease mechanisms exist to halt or cure Alzheimer's. He said while the incidence especially deaths due to neurodegenerative diseases like cancer are declining globally, AD has seen an increase of 75%. Thus, there is a need to develop drugs to halt or cure Alzheimer's. During our studies, brains affected with AD treated with TGR63 showed reduction of amyloid deposit during in therapeutic efficacy mice also showed reduction in learning deficiency and in impairment in emotional and social behavioural tests...

TIMES OF INDIA (February 2021)

DECCAN HERALD (February 2021)

### Alzheimer's disease reversible? Bengaluru scientists say 'possibly'

AKHIL KADIAL, BENGALURU, DHNS

Alzheimer's is one of the primary causes of dementia in people, and while the disease is considered irreversible, a cure may have been found by Bengaluru-based scientists.

The breakthrough is a small molecule which has shown the ability to disrupt the mechanism through which neurons become dysfunctional in Alzheimer's disease.

Developed by scientists from the Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR) and an Indian-origin scientist at the KTH Royal Institute of Technology in Sweden, the molecule, which has been called TGR63, has been shown in animal studies to not only halt the progress of the disease but even reverse it.

Alzheimer's is a person progresses through the abnormal buildup of naturally forming proteins which clump together to form plaques that collect between neurons and disrupt cell function.

Researchers say this is caused by production and deposition of the amyloid peptide (A) that accumulates in the central nervous system. The aggregation of this protein has the end effect of disrupting the neural network of the brain, resulting in memory loss and the destruction of thinking skills," said Prof T Govindaraju, from JNCASR.

The multifactorial nature of Alzheimer's disease is attributed to multifaceted amyloid toxicity, which has kept researchers from developing effective treatment, an official release stated, adding that small molecule found by the team can reduce the toxicity of amyloid beta (A) toxicity, and in doing so, can rescue neuronal cells.

The molecule was also found to reduce amyloid burden in the cortex and hippocampus, or a complex part embedded deep into the temporal lobe, thereby reversing cognitive decline.

The research has been published recently in the journal Advanced Therapeutics.

"Our animal studies show that mice with advanced stages of the disease can show a marked improvement in memory and thinking skills over a matter of days. In mice with early stages of the disease, recovery happened in a matter of hours," Professor Govindaraju told DH.

Video footage of tests showed a mouse with Alzheimer's treated with TGR63 and successfully navigating a Morris Water Maze from memory.

"However, we will only know the full scale of efficacy when human trials are conducted," Professor Govindaraju added.

Currently available treatments provide only temporary relief, and there are no approved drugs that directly act on the disease mechanisms of Alzheimer's.

INDIAN EXPRESS (February 2021)

### THE NEW INDIAN EXPRESS

STOCK MARKET BSE 49815.27 ▲ 598.75(1.22%) NSE 14735.85

Home > States > Karnataka

## JNCASR develops molecule that may help treat Alzheimer's

First identified over a 100 years ago, Alzheimer's disease has no major medication till date that can assist in permanent treatment.

Published: 25th February 2021 06:02 AM | Last Updated: 25th February 2021 06:02 AM

RAJASTHAN PATRIKA (Hindi) February 2021

### राजस्थान पत्रिका

10:49 PM

अल्जाइमर के उपचार के लिए कारगर दवा विकसित होने की उम्मीद बड़ी

अल्जाइमर के उपचार के लिए कारगर दवा विकसित होने की उम्मीद बड़ी

अल्जाइमर के उपचार के लिए कारगर दवा विकसित होने की उम्मीद बड़ी

Prasar Bharati Documentary on the invention

### अल्जाइमर्स... भारतीय वैज्ञानिकों को मिली बड़ी सफलता

(February 2021) <https://youtu.be/UkIZwB84udU>

THE ECONOMIC TIMES (February 2021)

ANI NEWS (February 2021)

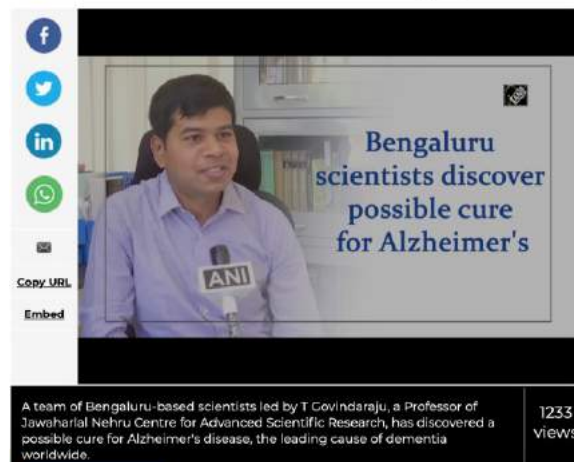
<https://youtu.be/4UJ1leSjgYk>



## Bengaluru-based scientists led by T Govindaraju discover possible cure for Alzheimer's

ANI | 27 Feb 2021, 11:29 PM IST

Post a Comment



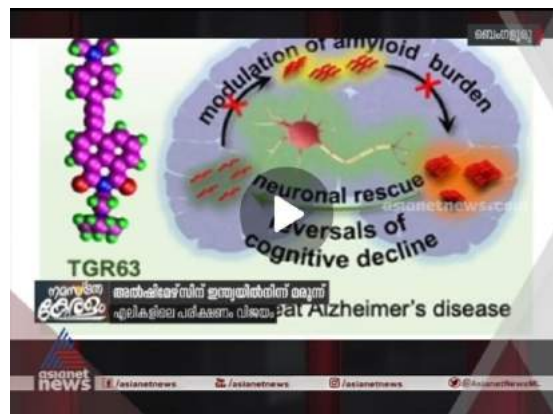
Professor T Govindaraju Jawaharlal Nehru Centre for Advanced Scientific Research

Bengaluru scientists discovers possible cure for Alzheimer's, now seeking funding for clinical trials

ANI | Updated: Feb 27, 2021 19:28 IST

**ASIANNET TV**  
(February 2021)

**(DOCUMENTARY)**



**LONGIVITY-  
TECHNOLOGY (UK)**

Researchers in India say they have discovered a promising drug target that may slow or even halt the progression of Alzheimer's.



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Highlighted in major newspapers and media/TV

[JNCASR Scientists develop a new molecule that could be a potential drug candidate for the treatment of Alzheimer's](#) (PIB, Gol, February 24, 2021)

[New molecule could be potential drug candidate to halt or cure Alzheimer's](#) (Times of India, February 26, 2021)

[Bengaluru scientists discovers possible cure for Alzheimer's, now seeking funding for clinical trials](#) (ANI News, February 26, 2021)

[Bengaluru scientists discover possible cure for Alzheimer's](#) (ANI News, February 27, 2021)

[Bengaluru-based scientists led by T Govindaraju discover possible cure for Alzheimer's](#) (The Economic Times, February 27, 2021)

[JNCASR team develops potential drug candidate for Alzheimer's](#) (The Hindu, March 06, 2021)

[JNCASR develops molecule that may help treat Alzheimer's](#) (The New Indian Express, February 25, 2021)

[Alzheimer's disease reversible? Bengaluru scientists say 'possibly'](#) (Deccan Herald, February 27, 2021)

[Bengaluru scientists discover molecule that could cure for Alzheimer's](#) (Deccan Herald, February 26, 2021)

[Scientists discover possible cure for Alzheimer's, seeks funds for trials](#) (Hindustan Times, February 27, 2021)

[JNCASR scientists develop molecule to halt dementia](#) (The Pioneer, February 26, 2021)

[Scientists develop new molecule that could halt, cure Alzheimer's](#) (The Federal, February 26, 2021)

[JNCASR develops potential drug candidate for Alzheimer's disease](#) (The BioSpectrum, February 26, 2021)

[Kiran Mazumdar-Shaw](#) (February 26, 2021)

[JNCASR Scientists Develop A New Molecule That Could Be A Potential Drug Candidate For The Treatment Of Alzheimer's](#). (The IndiaEducation Dairy.com, February 24, 2021)

[JNCASR Scientists develop potential drug candidate for Alzheimer's treatment](#) (Jagaran Josh, February 24, 2021)

[JNCASR Scientists Develop a New Molecule for Treatment of Alzheimer's](#) (SME Street, February 24, 2021)

[Indian Scientists Develop Novel Molecule That Could Be Potential Drug Candidate For Treatment Of Alzheimer's Disease](#) (Swarjaya Magazine, February 24, 2021)

**Behavioural studies show the reversal of cognitive decline in AD animal model.**

<https://onlinelibrary.wiley.com/action/downloadSupplement?doi=10.1002%2Fadtp.202000225&file=SupportingVideo3.avi>

<https://onlinelibrary.wiley.com/action/downloadSupplement?doi=10.1002%2Fadtp.202000225&file=SupportingVideo2.avi>

<https://onlinelibrary.wiley.com/action/downloadSupplement?doi=10.1002%2Fadtp.202000225&file=SupportingVideo1.avi>

## NATURAL PRODUCT BASED MULTIFUNCTIONAL INHIBITOR OF MULTIFACETED TOXICITY OF ALZHEIMER'S DISEASE

His group has developed a natural product derivative that effectively ameliorate multifaceted amyloid toxicity both *in vitro* and *in cellulo* conditions. The multifunctional attributes makes it a promising candidate for developing effective therapeutics to treat multifaceted toxicity of Alzheimer's disease.

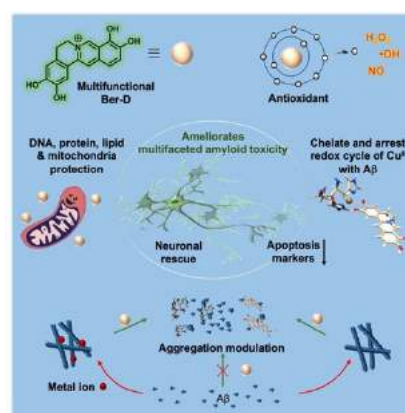
News highlights

[JNCASR scientists develop a natural product-based Alzheimer inhibitor](#) (PIB, GOI; DST, Gol, April 2020)

[Natural Product Based Alzheimer Inhibitor By JNCASR Scientists](#) (Biotechnika, May 07, 2020)

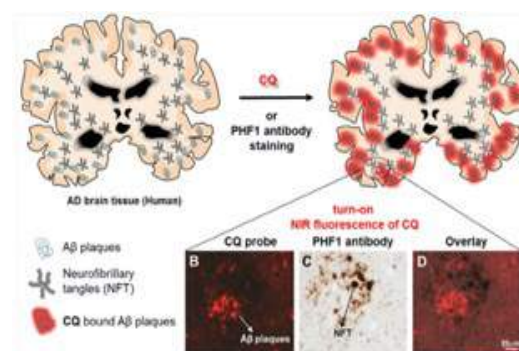
[Scientists at JNCASR develop berberine based Alzheimer's inhibitor "Ber-D"](#) (Biotechnika, April 29, 2020)

[JNCASR scientists develop a natural product based Alzheimer inhibitor](#) (Pharmatutor, IBEF, GK Series, April 2020)



## IV. ALZHEIMER'S DIAGNOSTICS (Translation)

His group has developed novel smart molecular tools with antibody selectivity and sensitivity, and methods for detection of Alzheimer's disease and to distinguish it from other neurodegenerative disorders (Unique technique to detect AD in case of mixed dementia). This invention is taken up for translation to develop affordable and early diagnosis for Alzheimer's disease (NIR/PET based brain imaging and detection of biomarkers in biofluids and retina) through the startup (VNIR Biotechnologies Pvt. Ltd.) founded by T. Govindaraju.

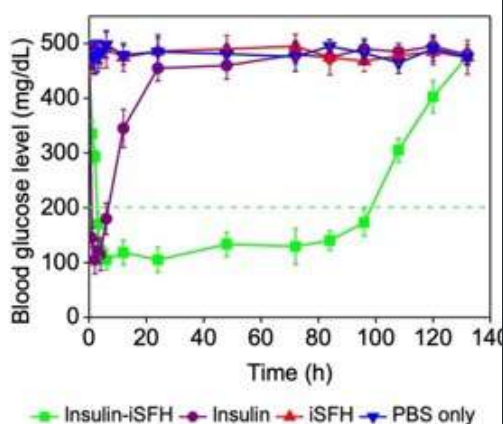
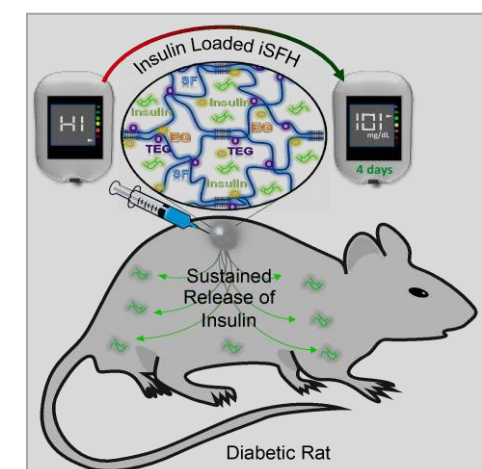


"**Health & Wellbeing Winner**" recognized by the **Commonwealth Chemistry** (UK) event (Federation of Commonwealth Chemical Sciences Societies) held across different continents and 38 countries.

[Alzheimer's disease \(diagnosis\) is profiled in Club SciWri](#) (April 5, 2018)

## V. INJECTABLE SILK-BASED FORMULATION FOR SUSTAINED INSULIN DELIVERY

Diabetes (T1D and T2D) is a chronic disease affecting over > 70 million in India and > 400 million people worldwide. The conventional and last resort of treatment involves repeated subcutaneous insulin injections, which cause pain, local tissue necrosis, infection, nerve damage and locally concentrated insulin amyloidosis responsible for inability to achieve physiological glucose homeostasis. Govindaraju group developed injectable silk fibroin hydrogel (iSFH) formulation for controlled and sustained (maintaining normal glucose levels for 4 days/administration) insulin delivery and the invention being considered for translation for human use.



**Dr Harsh Vardhan** @drharshvardhan · May 16


Prof. T. Govindaraju & his research team from @jncasr have developed the silk fibroin (SF) formulation using biocompatible additives and prepared an injectable SF hydrogel (iSFH) that can ease insulin delivery in diabetic patients.  
@IndiaDST @PMOIndia #MakeInIndia  
[Show this thread](#)

**JNCASR Bangalore** @jncasr · May 18  
@TGR\_JNC @jncasr

**Dr Harsh Vardhan** @drharshvardhan · May 16

Scientists at @jncasr, an autonomous research institute under the @IndiaDST, have recently developed an injectable Silk fibroin-based hydrogel for sustained insulin delivery in diabetic patients. A patent application has also been filed for this invention.  
@PMOIndia #MakeInIndia  
[Show this thread](#)

Jawahar Lal Nehru Centre for Advanced Scientific Research (JNCASR)  
scientists develop  
**INJECTABLE SILK FIBROIN-BASED HYDROGEL**  
for sustained Insulin delivery in diabetic patients





The importance and societal relevance (public health) of this invention were covered extensively,

[JNCASR scientists develop injectable Silk Fibroin-based hydrogel for sustained Insulin delivery in diabetic patients](#) (4 days sustainable insulin delivery) (DD News, May 15, 2020)

[Dr. Harsh Vardhan, Honourable Minister for Minister of Health & Family Welfare, Science & Technology, Earth Sciences, Govt.](#) (FB, May 16, 2020)

[Dr. Harsh Vardhan, Honourable Minister for Minister of Health & Family Welfare, Science & Technology, Earth Sciences, Govt.](#) (twitter, May 16, 2020)

[Scientists develop injectable silk fibroin-based hydrogel for sustained insulin delivery in diabetic patients](#) (Future Medicine, May 16, 2020)

[JNCASR Scientists Innovate for Diabetic Patients](#) (Medicircle, May 15, 2020)

[Scientists develop injectable hydrogel for sustained insulin delivery in diabetic patients](#) (The Poineer, May 15, 2020)

[New injectable hydrogel may ease insulin delivery in diabetic patients](#) (Asian Medical Tourism, May 15, 2020)

[Scientists of JNCASR develop injectable silk-fibroin-based hydrogel for insulin delivery in diabetic patients](#) (AffairsCloud, May 16, 2020)

[JNCASR develops injectable silk fibroin-based hydrogel for diabetic patients](#) (Devdiscourse News Desk, May 16, 2020)

[JNCASR develop injectable Silk Fibroin-based hydrogel for sustained Insulin delivery in diabetic patients](#) (Freshers Live, May 15, 2020)

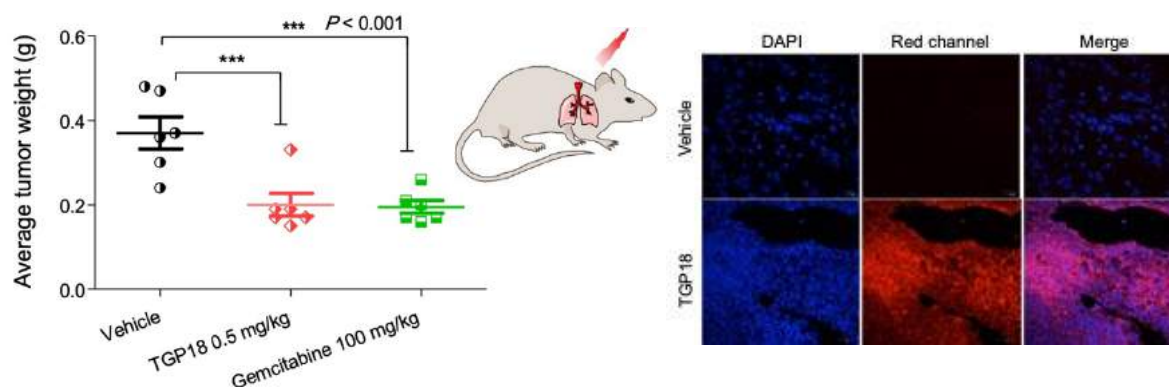
[Diabetes Patients Will Get Rid Of Repeated Insulin](#) (Hindi news, Rajasthan Patrika, May 31, 2020)

[All India Radio Vijayawada news](#) (AIRVijayawada news/TV, May 16, 2020)

## **VI. DIAGNOSTIC THERAPY (THERANOSTICS) FOR LUNG CANCER**

Lung cancer, the most common cause of cancer-related death worldwide is tough to detect at early stages, making it difficult to treat. Govindaraju group discovered a novel theranostic candidate TGP18 with anti-lung cancer activity and tumour tissue imaging potential (diagnosis and treatment of lung cancer). TGP18 is one of the first small molecule-based theranostic drug candidates for lung cancer with implications in personalized medicine. This invention has excellent clinical translational potential and in discussion with a pharma company for advanced toxicology and clinical studies.





This invention was highlighted by Kiran Mazumdar-Shaw and Dr. Harsh Vardhan, Honourable Minister for Minister of Health & Family Welfare, Science & Technology, Earth Sciences, GoI.



The importance and societal relevance of this invention for the detection and treatment of lung cancer is highlighted through extensive coverage

[JNCASR researchers develop diagnostic therapy for Lung Cancer](#) (DD News, September 02, 2020)

[JNCASR researchers develop diagnostic therapyfor Lung Cancer](#) (PIB, GOI, September 06, 2020)

[JNCASR researchers develop diagnostic therapy for Lung Cancer](#) (DST, GOI, September 02, 2020)

[Dr. Harsh Vardhan, Honourable Minister for Minister of Health & Family Welfare, Science & Technology, Earth Sciences, GoI.](#) (Twitter, September 03, 2020)

[Kiran Mazumdar-Shaw](#) (Twitter, September 08, 2020) (DST, GOI, September 02, 2020)

[Dr. Harsh Vardhan, Honourable Minister for Minister of Health & Family Welfare, Science & Technology, Earth Sciences, Govt.](#) (FB, September 03, 2020)

[Indian researchers develop diagnostic therapy for lung cancer](#) (Zee News, September 06, 2020)

[Researchers develop therapy that can detect lung cancer at early stage](#) (The Economic Times, September 07, 2020)

[JNCASR researchers develop diagnostic therapy for lung cancer](#) (PharmaBiz, September 07, 2020)

[JNCASR scientists develop novel diagnostic therapy for lung cancer](#) (Biotechnika, September 07, 2020)

[Indian researchers develop diagnostic therapy for lung cancer](#) (Newstube, September 07, 2020)

[JNCASR researchers developed diagnostic therapy for Lung Cancer](#) (FreshersLive, September 07, 2020)

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**Alzheimer's disease (Vol 1)**

**recent findings in pathophysiology, diagnostic and therapeutic modalities, Royal Society of Chemistry** (London) Publishing, 659 pages, **T. Govindaraju** (Ed.), **2021**. (In Press)



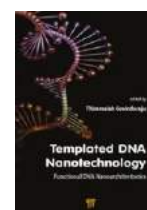
## Molecular Architectonics and Nanoarchitectonics

In the series of Nanostructure Science and Technology, **Springer Nature** (Singapore), 600 pages, Eds. **T. Govindaraju**, JNCASR, India and Katsuhiko Ariga, NIMS, Japan, **2021**. (In Press)

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## Research Publications in International Journals

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130. S. Pratihari, V. Kumar, R. Agrawal, A. Singh and **T. Govindaraju**, Reliable and selective fluorometric detection of SARS-CoV-2, **2021** (*Submitted*).
129. L. P. Datta, H. Moorthy and **T. Govindaraju**, Multifunctional hybrid architectures of cyclic dipeptide oligomer with gold nanoparticles and polyoxometalates modulate multifaceted amyloid toxicity of Alzheimer's disease, **2021** (*To be communicated*).
128. M. Konar, D. Ghosh, and **T. Govindaraju**, De novo designed A $\beta$ 14-23 peptidomimetics combat amyloidogenic stress induced cellular toxicity and stiffness, **2021** (*Submitted*).
127. D. Ghosh, M. Konar, T. Mandal and **T. Govindaraju**, A $\beta$ 14-23 Architectonics for differential stabilization of copper oxidation states and catalysis, **2021** (*Submitted*).
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125. P. Sengupta, Y. V. Suseela, N. Banerjee, A. Dutta, T. Roychowdhury, A. Dutta, K. Jana, G. Mukherjee, S. Chattopadhyay, **T. Govindaraju** and S. Chatterjee, Understanding the role of G-quadruplex structural dynamics at MAPK12 promoter in regulating cancer stemness, **2021** (*Submitted*).
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120. C. Balachandra, D. Padhi, and **T. Govindaraju**, Cyclic dipeptide: a privileged molecular scaffold to derive structural diversity and functional utility, **ChemMedChem** **2021**, doi: 10.1002/cmdc.202100149.

119. S. Samanta, K. Rajasekhar, M. Ramesh, N. A. Murugan, S. Alam, D. Shah, J. P. Clement and **T. Govindaraju**, Naphthalene monoimide derivative ameliorates amyloid burden and cognitive decline in a transgenic mouse model of Alzheimer's disease, **Adv. Therap.** **2021**, *4*, 2000225. (*Cover Page Article*)

A novel drug candidate (TGR63) discovered for the treatment of Alzheimer's disease. The efficacy of TGR63 is demonstrated in AD animal model, showed significant reduction of amyloid burden in the AD brain and reversal of cognitive decline. This drug candidate is taken up for clinical studies by a pharmaceutical company.

Highlighted in major newspapers and media/TV



118. H. Moorthy and **T. Govindaraju**, Dendrimer Architectonics to Treat Cancer and Neurodegenerative Diseases with Implications in Theranostics and Personalized Medicine, **ACS Appl. Bio Mater.** **2021**, *4*, 1115-1139. Discuss inverse relationship between cancer and neurodegenerative disease (eg. Alzheimer's disease).


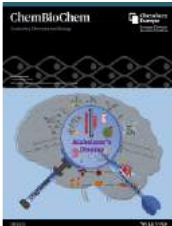
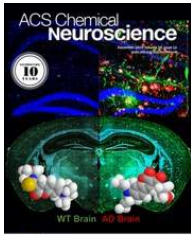
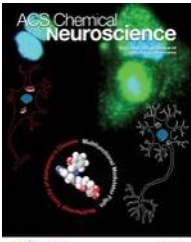


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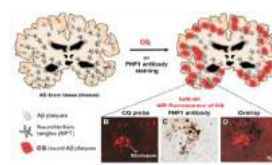
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