

# Bio-Data

Annexure 1



## **K.G. RAGHU, Ph D**

(Former Chief Scientist CSIR NIIST)

Scientist 4/07/2023

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## EMPLOYMENT HISTORY

Sr.no	Position	Period	Duties	Institute
1	Scientist B	18/9/1995- 17/9/2000	Drug development for CVD & Safety Pharmacology	CSIR Central Drug Research Institute, Lucknow
2	Scientist C	18/9/2000- 17/9/2006	Drug development for CVD & Safety Pharmacology	CSIR Central Drug Research Institute, Lucknow
3	Senior scientist	18/9/2006- 14/9/2008	Drug development for CVD & Safety Pharmacology	CSIR Central Drug Research Institute, Lucknow
4	Senior scientist	15/9/2008- 17/9/2010	Research on basic biology of cardio- metabolic syndromes and development of leads	CSIR-National Institute for Interdisciplinary Science & Technology (NIIST), Trivandrum-19
5	Principal Scientist	18/09/2010 – 17/09/2015	Research on basic biology of metabolic syndromes and development of leads	CSIR-National Institute for Interdisciplinary Science & Technology (NIIST), Trivandrum-19
6	Senior Principal Scientist	18/09/2015- 31/3/2022	Research on basic biology of metabolic syndromes and development of leads	CSIR-National Institute for Interdisciplinary Science & Technology (NIIST), Trivandrum-19

## EDUCATION

Degree Passed	University/institution	Subjects	Grade obtained	Year of passing
BSc	Calicut University	Zoology, Botany & Chemistry	First class 73.1%	1983
MSc	Calicut University	Zoology	First class 66%	1985
PhD	Saurashtra University	Experimental Biology		1991

## DETAILS OF PhD AND POST DOCTORAL RESEARCH

## Bio-Data

**Title of PhD thesis:** Effect of organomercurials pollution in animals: Evaluation of biochemical changes in the central nervous system of rat with methylmercury and chelators.

Period of course: 1986 to 1991)

Supervisor: Prof. P. P. Sood

Institute: Bioscience department, Saurashtra University, Rajkot, Gujarat.

### Details of Post-Doctoral research

Topic: Neurotransmitter – receptor function in mercury poisoning and chitosan effect  
Supervisor: Dr. C. S. Paulose.

Period of course: 1992-1995

Institute: Department of Biotechnology, Cochin University of Science & Technology, Cochin.

## CONTRIBUTION IN HUMAN RESOURCE DEVELOPMENT

### ▪ Details of Post-doctoral research supervision

Name of candidate	Funding agency	Title of project	Duration
Dr. Vandana Sanker	DBT	Elucidation of the role of oxidative stress in cardiac hypertrophy and evaluation of protective effect of some potent antioxidant phytochemicals against it: an in vitro cell line based approach.	2010-2015
Dr. Shyni GL	DBT	Identification of dual /pan agonists of PPAR $\gamma$ from natural resources for metabolic syndrome.	2014-2017
	KSCSTE	Exploration of Mitochondria associated membrane (MAM) as a therapeutic target for insulin resistance and metabolic inflexibility	2018-2019
	DHR	Identification of proprotein convertase subtilisin kexin-9 (PCSK-9) inhibitors from Garcinia cambogia	2019-2022

## Bio-Data

Dr.Sindhu. G	KSCSTE	Exploration of bioactive compounds from <i>Garcinia travancorica</i> Bedd for the development of PPAR- $\alpha$ modulators.	2016-2017
	DHR	Development of biflavonoid based lead molecule (NIIST-OBT-2) from <i>Garcinia travancorica</i> for non-alcoholic fatty liver disease (NAFLD).	2018-2021
Genu George	SERB	Generation of potential VEGF, JAK1/ JAK 2 and IL-17 modulators for rheumatoid arthritis from traditional medicinal plants	2017 – 2020
	ICMR	Plant derived JAK1/JAK2 modulators for osteoclastogenesis and bone resorption in arthritis	2021-2023
Soumya R S	DHR	Development of guar gum nanoparticle based mitochondrial antioxidants for cardiac hypertrophy.	2019-2022.

### ▪ Details of doctoral degree awarded and ongoing PhD students

Sl. No	Title	Year of awarded	Name of Scholar
1	Elucidation of key molecular mechanisms responsible for antidiabetic property of <i>Aerva lanata</i> (L.) Juss.ex Schult.	2014	Riya Mariam Philip
2	Investigation of key molecular targets responsible for antidiabetic properties of <i>Symplocos cochinchinensis</i> (Lour.)S.Moore	2014	Antu K Antony
3	Investigation on phytochemical constituents and biological potential of some traditional medicinal plants	2014	Priya Rani M (as a co-supervisor )
4	Studies on cardiac hypertrophy and its possible attenuation by <i>Boerhaavia diffusa</i> L.	2015	Prathapan A
5	Elucidation of molecular events underlying hypoxia induced dysfunctions in 3T3-L1 adipocytes and possible amelioration with bilobalide and curcumin.	2015	Priyanka A
6	An in vitro evaluation of selenium incorporated guar gum nanoparticles against ischemia reperfusion in H9c2 cardiomyoblast	2015	Soumya R S
7	Elucidation of mechanisms involved in arsenic trioxide induced cardiotoxicity and its possible amelioration with phloretin.	2015	Vineetha V P
8	Punicic acid, a partial PPAR gamma agonist, enhances insulin sensitivity in 3T3-L1 adipocytes by safeguarding mitochondria and ameliorating inflammation.	2016	Anusree S S
9	Beneficial effect of <i>Tribulus terrestris</i> L.against ischemia in H9c2 cells and isoproterenol induced cardiac dysfunctions in rats.	2016	Reshma P L

## Bio-Data

10	An in vitro investigation on cellular and molecular alterations in the biology of 3T3-L1 adipocytes during endoplasmic reticulum stress and possible protection by (-) hydroxycitric acid.	2016	Nisha V M
11	Elucidation of hyperglycaemia mediated cellular and molecular changes in heart and possible beneficial effect of ferulic acid	2021	Salin Raj P
12	Evaluation of beneficial effect of cinnamic acid against hyperglycaemic cardiomyopathy with special emphasis on oxidative stress and inflammation	2021	Anupama Nair
13	Exploration of ER stress and associated complications in diabetic cardiomyopathy and possible amelioration with chlorogenic acid	2021	Preetha Rani MR
14	Development of surface enhanced Raman scattering based diagnostic platform for Cancer and Alzheimer's Disease"	2021	Varsha Karunakaran (As Co-Supervisor)

### ▪ On Going PhDs

Sr.No	Title of thesis	Year of joining	Name of candidate
1	Evaluation of anti-diabetic potential of medicinal plants and their compounds.	2016	Sreelekshmi Mohan
2	Validation of potential role of fructose and inflammation in the genesis of insulin resistance.	2016	Swapna Sasi U S
3	Development of Insulin resistance via Methylglyoxal	2017	Sruthi C R
4	Molecular characterization of genes associated with ciliopathies	2017	Roopasree O J

### ▪ Details of Master's Thesis (MSc, MPharm, MTech, MVSc ) supervised

Sl.No:	Title	Year awarded	Name of scholar
1	Characterization of cytotoxicity induced by arsenic trioxide (a potent anti-APL drug) in rat cardiac myocytes.	2007	Lijo Cherian (M Sc) (St Thomas College, Bhopal)
2	Haloperidol induced cardiac adverse effects: Studies on ventricular action potential and structural alterations	2007	Richa Singh (M Pharm) (Dept of pharmaceuticals, institute of technology, BHU, Varanasi)

## Bio-Data

3	Study on adverse effect of arsenic trioxide (a potent anti-APL drug on guinea pig myocardium an electrophysiological and molecular approach)	2007	Govindakumar Yadav (M V Sc) (Narendra Deva University of Agriculture & Technology Kumarganj, Faizabad, 224229 UP)
4	Evaluation of pro-arrhythmic potential of various categories of drugs using electrophysiological techniques	2008	Saket Singh Chandel (M Pharm), (Ultra College of pharmacy, Madurai, TN.
5	Effect of estradiol on cardiac action potential	2008	Praveen Bansal (M Pharm) (Vinayaka Missions College of Pharmacy – [VMCP], Salem
6	Evaluation of antioxidant potential of <i>Boerhaavia diffusa</i>	2009	Mukesh Kumar Singh (M Pharm) (SRM College of Pharmacy, Kattankulathur)
7	Amelioration effect of <i>Centella asiatica</i> on iron induced lipid peroxidation in liver homogenate: An in vitro study	2009	Muneer A M (M Sc) (Thanthai Hans Roever College, Peramballur)
8	Phenolic compounds from <i>Centella asiatica</i> protect tert-butyl hydroperoxide induced oxidative stress in C2C12 cell lines	2010	Minnath K A (M Sc) (School of Biosciences, Mahatma Gandhi University, Kottayam)
9	Neuroprotection by phenolic compounds from <i>Boerhaavia diffusa</i> L. against chemically induced neurotoxicity: an in vitro study	2010	Salin Raj P (M Sc) (School of Biosciences, Mahatma Gandhi University, Kottayam)
10	Bioactives from pineapple ( <i>Ananas cosmosus</i> ) residue with potential medicinal properties	2010	Vinu T (M Sc) (School of Biosciences, Mahatma Gandhi University, Kottayam)
11	Anti diabetic and anti oxidant potentials of <i>Spirulina platensis</i> and SEM studies of its anti glycation activity	2012	Aarathy Dharshana Lipton (M Sc) (Govt. College of Technology, Coimbatore)
12	Cardioprotective properties of <i>Tribulus terrestris</i> extracts against ischemic injury in H9c2 cell line	2012	Lekshmi V S (M Sc) (School of Biosciences, Mahatma Gandhi University, Kottayam)
13	Evaluation of antioxidant, digestive enzyme (related to diabetes) inhibitory properties and anti glycation effects of <i>Terminalia chebula</i> leaves	2012	Swayhi Lakshmi M (M Sc) (Bharathidasan University)
14	<i>Tribulus terrestris</i> attenuate ischemia induced alterations in H9c2 cells via its antioxidant potential	2013	Neethu S Sainu (M Tech) (Sree Budha College of Engineering, Alappuzha)
15	Study on antioxidant and aldose reductase inhibitory potential of <i>Parmotrema tinctorum</i> (Nyle) hale to prevent diabetic cataract	2013	Jomon Sebastian (M Tech) (SreeBudha College of Engineering, Alappuzha)
16	Antioxidant efficacy of vanadium	2013	Reshmi Raj (M Sc)

## Bio-Data

	encapsulated guar gum nanoparticle: an <i>in vitro</i> study		(Cochin University of Science and Technology)
17	Green synthesis of iron nanoparticles using <i>Centella asiatica</i> and evaluation of antioxidant and cytoprotective potentials by <i>in vitro</i> methods.	2014	Maya M L (M Sc) (AmritaVishwaVidyapeetham)
18	Green synthesis and characterization of cerium nanoparticles and its evaluation against cardiomyoblast hypertrophy	2014	Athira Raj (M Sc) (SreeBudha College of Engineering, Alappuzha)
19	An <i>in vitro</i> study reveals atranorin, from <i>Parmotrema tinctorum</i> , is a potential lead for metabolic syndrome	2014	Sreelekshmi L (M Sc) (University of Kerala, Kariavattom)
20	Green synthesis of zinc oxide nanoparticles by polyphenol extract: characterization and evaluation of their antioxidant potential.	2015	Reshma P (M Sc) (Govt.College, Kasargod)
21	Synthesis and characterization of MgO nanoparticles using <i>Aerva lanata</i> leaf extract, determination of their free radical scavenging activity and interaction with H9c2 cells	2015	Nazrin Fathima T (M Sc) (Bharathidasan University)
22	Fukugiside from <i>Garcinia travancorica</i> attenuates hyperglycemia mediated oxidative stress and calcium overload: Evident from cell free and cell based (H9c2 cardiomyoblast) study	2015	Vinodh J S (M Sc) (Anna University, Chennai)
23	Antioxidant effect of <i>Parmotrema tinctorum</i> , against streptozotocin induced oxidative stress in HepG2 cells	2016	Deepti E Kuriakose (M Sc) (Mar A Athanasios College)
24	17-Beta hydroxyazadiradione, a terpenoid from <i>Azadirachta indica</i> is potent antioxidant, evident from both cell free and cell based investigations	2016	Aleena Raju (M Sc) (CUFOS, Cochin)
25	<i>In vitro</i> investigation of the potential health benefits of triazole appended labdane isolated from <i>Curcuma amada</i> Roxb roots.	2017	M N Ahammad Nabeel (M Sc) (Mar Athanasios College for Advanced Studies Tiruvalla)

### ▪ Teaching Experience

Level	Subjects taught	Duration of teaching
PhD course work	1.Molecular and cellular biology of diabetes	2008-continuing
	2.Heart disease biology	2008-continuing

## FELLOW OF LEARNED ACADEMIES

Fellow of Indian Academy of Biomedical Sciences.

I have been nominated for Fellowship of National Academy of Medical Sciences India, Nation Academy of Science India and Indian National Academy, all of which are under process.

## CONTRIBUTION TOWARDS UPLIFTMENT OF SCIENCE

### Membership in organization / national / international committees

- ✓ President, Indian Academy of Biomedical Sciences
- ✓ Executive member of Kerala Academy of Sciences
- ✓ Executive Member, Society for Biotechnologist, India
- ✓ Member of Academic Council of subject 'integrative biology' of Kerala University
- ✓ Served as Member, Animal Ethics Committee, MG University, Kottayam, Kerala.
- ✓ Served as Technical expert committee member (purchase), Directorate of Geology and Mining, Govt. of Kerala.
- ✓ Member, Association of Biotechnologist and Pharmacist

### Examiner for MPhil & PhD Thesis

- ✓ University of Kerala
- ✓ University of Calicut
- ✓ CUSAT, Cochin
- ✓ MS University, Thirunelveli,
- ✓ Annamalai University, Annmalai,
- ✓ JN Technical University, Hyderabad
- ✓ University of Southern Queensland, Australia
- ✓ JNU, Delhi,
- ✓ AcSIR, New Delhi
- ✓ MG University, Kerala
- ✓ S V University, Tirupathi
- ✓ Nizam Institute of Medical Sciences, Hyderabad
- ✓ Symbiosis University, Pune

# Bio-Data

## Contribution to various scientific journals & funding agencies

**Co-Editor** : Journal of Tissue Research

### Reviewer (Journals)

- ✓ Journal of medicinal chemistry research
- ✓ Life sciences
- ✓ Journal of medicinal food
- ✓ Journal of food biochemistry.
- ✓ Journal of pharmacology and toxicology
- ✓ Natural products research
- ✓ Human and experimental toxicology
- ✓ Toxicology and industrial health
- ✓ British journal of nutrition
- ✓ Frontiers in pharmacology
- ✓ Biomedicine and pharmacotherapy
- ✓ Journal of ethanopharmacology
- ✓ Food and function
- ✓ Cardiovascular toxicology
- ✓ Food and chemical toxicology
- ✓ Cell signalling
- ✓ Phytomedicine

### Reviewer (Research funding agencies):

- ✓ DST, .
- ✓ CSIR, Delhi
- ✓ Kerala State Council for Science, Technology & Environment, Thiruvananthapuram
- ✓ UGC, Delhi
- ✓ DBT, Delhi
- ✓ Wellcome Trust Allianace
- ✓ Indo-French Centre for the Promotion of Advanced Research, NDelhi
- ✓ Spices Board

## PUBLICATIONS

### Publications

#### Papers in previewed SCI journals

1. Sood P.P., Unnikumar, K.R., Vinay S.D., Raghu K.G. and Wegmann R. Duration dependent effect of methyl mercury chloride and antagonists on the enzymes of central nervous system of rat: ii Acid phosphatase study on the brain. Cell. Mol. Biol. 34, 271-277 (1988).
2. Vinay S.D., Raghu K.G., and Sood P.P. Therapeutic profiles of metal chelators in the detoxication of methyl mercury inhibited acid and alkaline phosphatases in the central nervous system of rat. J. Environ. Pathol. Toxicol. Oncol. 9, 351-361 (1990).
3. Vinay S.D., Raghu K.G., and Sood P.P. Dose and duration related methyl



## Bio-Data

mercury deposition, glycosidases inhibition, and myelin degeneration and chelation therapy. *Cell. Mol. Biol.* 36, 509-623 (1991).

4. Vinay S.D., Raghu K.G., and Sood P.P. Differential therapeutic responses of thiol compounds in the reversal of methyl mercury inhibited acid phosphatase and cathepsin E in the central nervous system of rat. *Bull. Environ. Contam. Toxicol.* 49, 78-84 (1992).
5. Raghu K.G., Kodi R.B., Vijayalakshmi K., Bapu C and Sood P.P. Inefficiency of metal chelators to promote recovery of methyl mercury inhibited CNS succinic dehydrogenase *Acta Neurol Belg.* 92, 157-164 (1992).
6. Sood P.P., Raghu K.G., Bapu C., and Vijayalakshmi K. Temporal fluctuations of acetyl cholinesterase in central nervous system of rat during methyl mercury toxication and Chelation therapy. *J. Environ. Pathol. Toxicol. Oncol.* 8, 32-38 (1993).
7. Seema P.V., Sudha B., Pius S. Padayatti., Asha Abraham., Raghu K.G., and Paulose C.S. Kinetic studies of purified malate dehydrogenase in liver of streptozotocin diabetic rats and the effect of leaf extract of *Aegle marmelose* (L) *Correa ox Roxb. Ind. J. Exp. Biol.* 34, 600-602 (1996).
8. Preetha N., Pius S.P., Asha A., Sudha B., Raghu K.G., and Paulose C.S. Glutamate dehydrogenase induction in the brain of streptozotocin diabetic rats. *Ind. J. Biochem. Biophys.* 33, 428-430 (1996).
9. Gautam M., Dixit C., Singh S., Tewari A., Raghu K.G., Prakash P., and Tripathi O. Frequency and time dependent effect of fendiline on action potential of *G. pig* papillary muscle. *Jap. J. Pharmacology* 83, 175-181 (2000).
10. Tiwari P., Tripathi L.M., Raghu K.G., and Srivastava V.M.L. Presence of Octopamine receptor in *Acanthocheilonema viteae*, a rodent filarial parasite. *J. Expt. Prasitology*, 108, 53-58 (2004).
11. Raghu K.G. Effect of melittin on electrically driven action potential of *G.pig* papillary muscle. *J Cell. Tissue Res.* 6, 749-752 (2006). ★
12. Raghu K.G., and Cherian O.L. Characterization of cytotoxicity induced by arsenic trioxide (a potent anti-APL drug) in rat cardiac myocytes. *J. Trace Elem. Med. Biol.* 23, 61-68 (2009). ★
13. Raghu K.G., Richa Singh, Prathapan A., and Yadav G.K. Modulation of haloperidol induced electrophysiological alterations on cardiac action potential by various risk factors and gender difference. *Chem. Biol. Interact.* 180, 454-459 (2009). ★
14. Prathapan A., Likhman M., Arumughan C., Sundaresan A., and Raghu K.G. Effect of heat treatment on curcuminoid, color value and total polyphenols

## Bio-Data

- of fresh turmeric rhizome. *Int. J. Food Sci. Technol.* 44, 1438-1444 (2009). ★
15. Raghu K.G., Govind Kumar Yadav, Richa Singh, Prathapan A., Sharad Sharma, and Smrati Bhaduarua. Evaluation of adverse cardiac effects induced by Arsenic trioxide, a potent anti-APL drug. *J. Environ. Pathol. Toxicol. Oncol.* 28, 241-252 (2009). ★
  16. Abhilash P.A., Nisha P., Prathapan A., Nampoothiri S.V., Cherian O. L., Sunitha T. K., and Raghu K. G. Cardioprotective effects of aqueous extract of *Oxalis corniculata* in experimental myocardial infarction. *Exp. Toxicol. Pathol.* 63, 535- 540 (2010). ★
  17. Priya Rani M, Padmakumari K.P., Sankarikutty B., Cherian O.L., Nisha V.M., and Raghu K.G. Inhibitory potential of ginger extracts against enzymes linked to type 2 diabetes, inflammation and induced oxidative stress. *Int. J. Food Sci. Nutr.* 62, 106-110 (2011).
  18. Prathapan A., Mukesh Kumar Singh, Anusree S.S., Soban Kumar D.R., Sundaresan A., and Raghu K.G. Antiperoxidative, free radical scavenging and metal chelating activities of *Boerhaavia diffusa* L. *J. Food Biochem.* 35, 1548-1554. (2011). ★
  19. Prathapan A., Cherian O.L., Nampoothiri S.V., Mini S., and Raghu K.G. In vitro antiperoxidative, free radical scavenging and xanthine oxidase inhibitory potentials of ethyl acetate fraction of *Saraca ashoka* flowers. *Nat. Prod. Res.* 25, 298-309 (2011). ★
  20. Prathapan A., Fahad K., Thomas B.K., Philip R.M., and Raghu K.G. Effect of sprouting on antioxidant and inhibitory potential of two varieties of Bengal gram (*Cicer arietinum* L.) against key enzymes linked to type-2 diabetes. *Int. J. Food Sci. Nutr.* 62, 234-238 (2011). ★
  21. Nampoothiri S.V., Prathapan A., Cherian O.L., Raghu K.G., Venugopalan V.V., and Sundaresan A. In vitro antioxidant and inhibitory potential of *Terminalia bellerica* and *Emblica officinalis* fruits against LDL oxidation and key enzymes linked to type 2 diabetes. *Food Chem. Toxicol.* 49, 125-131 (2011).
  22. Sasidharan I., Sundaresan A., Nisha V.M., Kirishna M.S., Raghu K.G., and Jayamurthy P. Inhibitory effect of *Terminalia chebula* Retz. fruit extracts on digestive enzyme related to diabetes and oxidative stress. *J. Enzyme Inhib. Med. Chem.* 27, 578-586 (2012).
  23. Prathapan A., Nampoothiri S.V., Mini S., and Raghu K.G. Antioxidant, antiglycation and inhibitory potential of *Saraca ashoka* flowers against the enzymes linked to type 2 diabetes and LDL oxidation. *Eur. Rev. Med. Pharmacol. Sci.* 16, 57-65 (2012). ★

## Bio-Data

24. Rani M.P., Krishna M.S., Padmakumari K.P., Raghu K.G., and Sundaresan A. Zingiber officinale extract exhibits antidiabetic potential via modulating glucose uptake, protein glycation and inhibiting adipocyte differentiation: an in vitro study. *J. Sci. Food Agric.* 92, 1948-1955 (2012).
25. Lekshmi P.C., Arimboor R., Raghu K.G., and Menon A.N. Turmerin, the antioxidant protein from turmeric (*Curcuma longa*) exhibits antihyperglycaemic effects. *Nat. Prod. Res.* 26, 1654-1658 (2012).
26. Prathapan A., Cherian O.L., Nampoothiri S.V., Mini S., and Raghu K.G. In vitro antiperoxidative, free radical scavenging and xanthine oxidase inhibitory potentials of ethyl acetate fraction of *Saraca ashoka* flowers. *Nat. Prod. Res.* 25, 298-309 (2011). ★
27. Prathapan A., Krishna M.S., Nisha V.M., Sundaresan A., and Raghu K.G. Polyphenol rich fruit pulp of *Aegle marmelos* (L.) Correa exhibits nutraceutical properties to down regulate diabetic complications - An in vitro study. *Food Research International*, 48, 690-695 (2012). ★
28. Sankar V., Pangayarselvi B., Prathapan A., and Raghu K.G. *Desmodium gangeticum* (Linn.) DC. exhibits antihypertrophic effect in isoproterenol-induced cardiomyoblasts via amelioration of oxidative stress and mitochondrial alterations. *J. Cardiovasc. Pharmacol.* 61, 23-34 (2013). ★
29. Vineetha V.P., Prathapan A., Soumya R.S., and Raghu K.G. Arsenic trioxide toxicity in H9c2 cardiomyocytes damage to cellular organelles and possible amelioration with *Boerhaavia diffusa* L. *Cardiovasc. Toxicol.* 13, 123-137 (2012). ★
30. Ajish K.R., Dhanya B. P., Nayana Joseph, Priya Rani M., Raghu K.G., Vineetha V. P., and Radhakrishnan K.V. Synthesis of novel zerumbone derivatives via regioselective palladium catalyzed decarboxylative coupling reaction: A new class of alpha-glucosidase inhibitors. *Tetrahedron Lett.* 55, 665-670 (2014). ★
31. Soumya R.S., Vineetha V.P., Reshma P.L., and Raghu K.G. Preparation and Characterization of Selenium incorporated Guar Gum nanoparticle and its interaction with H9c2 cells. *Plos One.* 8, e74411 (2013). ★
32. Riya M.P., Antu K.A., Vinu T., Chandrakanth K.C., Anilkumar K.S., and Raghu K.G. An in vitro study reveals nutraceutical properties of *Ananas comosus* (L.) Merr. var. *Mauritius* residue beneficial to diabetes. *J. Sci. Food Agric.* 94, 943-950 (2014). ★
33. Ajish K.R., Joseph N., Priya Rani M., Raghu K.G., Vineetha V.P., and Radhakrishnan K.V. Synthesis and biological evaluation of carbohydrate appended hydrazinocyclopentenes with potent glycation and alpha-glucosidase inhibition activities. *Tetrahedron Lett.* 54, 5682-5685 (2013).

## Bio-Data

34. Finosh G.T., Jayabalan M., Sankar V., and Raghu K.G. Growth and survival of cells in biosynthetic poly vinyl alcohol–alginate IPN hydrogels for cardiac applications. *Colloids and Surf. B: Biointerfaces*. 107, 137-145 (2013).
35. Divya V., Sankar V., Raghu K.G., and Reddy M.L. A mitochondria-specific visible-light sensitized europium-diketonate complex with red emission. *Dalton Trans.* 42, 12317-12323 (2013).
36. Prathapan A., Vineetha V.P., Abhilash P.A., and Raghu K.G. *Boerhaavia diffusa* L. attenuates angiotensin II-induced hypertrophy in H9c2 cardiac myoblast cells via modulating oxidative stress and down-regulating NF-KB and transforming growth factor  $\beta$ 1. *Br. J. Nutr.* 110, 1201-1210 (2013). ★
37. Soumya R.S., Reshmi R., Jomon S., Antu K.A., Riya M.P., and Raghu K.G. Synthesis, characterization and evaluation of antioxidant potential of vanadium encapsulated guar gum nanoparticles. *Food Funct.* 5, 535-544(2014). ★
38. Vineetha V.P., Girija S., Soumya R.S., and Raghu K.G. Polyphenol rich apple (*Malus domestica* L.) peel extract attenuate arsenic trioxide induced cardiotoxicity in H9c2 cells via its antioxidant activity. *Food Funct.* 5, 502-511 (2014). ★
39. Riya M.P., Antu K.A., Pal S., Srivastava A.K., Sharma S., and Raghu K.G. Nutraceutical potential of *Aerva lanata* (L.) Juss. ex Schult ameliorates secondary complications in streptozotocin-induced diabetic rats. *Food Funct.* 5, 2086-2095 (2014). ★
40. Antu K.A., Riya M.P., Mishra A., Sharma S., Srivastava A.K., and Raghu K.G. *Symplocos cochinchinensis* attenuates streptozotocin-diabetes induced pathophysiological alterations of liver, kidney, pancreas and eye lens in rats. *Exp. Toxicol. Pathol.* 66, 281-291 (2014). ★
41. Prathapan A., Vineetha V.P., and Raghu K.G. Protective effect of *Boerhaavia diffusa* L. against mitochondrial dysfunction in angiotensin II induced hypertrophy in H9c2 cardiomyoblast cells. *PLoS One* 9, e96220 (2014). ★
42. Rani M.P., Raghu K.G., Nair M.S., and Padmakumari K.P. Isolation and identification of  $\alpha$ -glucosidase and protein glycation inhibitors from *Stereospermum colais*. *Appl. Biochem. Biotechnol.* 173, 946-956 (2014).
43. Salin Raj P., Prathapan A., Sebastian J., Antony A.K., Riya M.P., Rani M.R., Biju H., Priya S., and Raghu K.G. *Parmotrema tinctorum* exhibits antioxidant, antiglycation and inhibitory activities against aldose reductase and carbohydrate digestive enzymes: an in vitro study. *Nat. Prod. Res.* 28, 1480-1484 (2014). ★

## Bio-Data

44. Priyanka A., Nisha V.M., Anusree S.S., and Raghu K.G. Bilobalide attenuates hypoxia induced oxidative stress, inflammation, and mitochondrial dysfunctions in 3T3-L1 adipocytes via its antioxidant potential. *Free Radic. Res.* 48, 1206-1217 (2014). ★
45. Maniganda S., Sankar V., Nair J.B., Raghu K.G., and Maiti K.K. A lysosome-targeted drug delivery system based on sorbitol backbone towards efficient cancer therapy. *Org. Biomol Chem.* 12, 6564-6569 (2014).
46. Nisha V.M., Anusree S.S., Priyanka A., and Raghu K.G. Apigenin and Quercetin ameliorate mitochondrial alterations by tunicamycin induced ER Stress in 3T3-L1 adipocytes. *Appl. Biochem. Biotechnol.* 174, 1365-1375 (2014). ★
47. Priyanka A., Anusree S.S., Nisha V.M., and Raghu K.G. Curcumin improves hypoxia induced dysfunctions in 3T3-L1 adipocytes by protecting mitochondria and down regulating inflammation. *Biofactors.* 40, 513-523 (2014). ★
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Clinically Confirmed Grades of Cervical Exfoliated Cells by Dual Biomarker-Appended SERS-Tag. Anal Chem. 10.1021 (2021).

103. Preetha Rani M R, Salin Raj P, Anupama Nair, Ranjith R, Rajankutty ,Raghu K G. In vitro and in vivo studies reveal the beneficial effects of chlorogenic acid against ER stress mediated ER phagy and associated apoptosis in the heart of diabetic rat .Chemico Biol Inter ,2021 doi: 10.1016/ in press. ★
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★ Corresponding author (68).

Patent: Under process

'Pyrazole Amide Based Compounds And Uses Against Breast Cancer Thereof'

Inventor(s) Sulochana Priya (Principal Investigator), Sasidhar Balappa Somappa, Kozhiparambil Gopalan Raghu,Sreerenjini Lakshmi, Kizhakkan Thiruthi Ashitha

CSIR-SRF, CSIR-National Institute For Interdisciplinary Science And Technology, Trivandrum-695019, Kerala, India.

### Books

Co-Author: Methyl mercury Toxication and Chelation (ISBN-81-7238-013)By P.P Sood, S.D.Vinay, and K.G.Raghu, Published by Venus Publishing House, New Delhi.1993

### Book chapters

1. Majid M.A., Babu C., Vijayalakshmi K, Raghu K.G., Vinay S.D and Sood P.P: Effect of Chlorohydrin toxicity in testis and epididymis of mice: A histological and biochemical study. Environ. Strat. Biosciences. I, 29-36 (1989).

2. Raghu K.G., Vinay S.D. and Sood P.P. Effect of methylmercury and antagonists on the central nervous system adenosine triphosphatases. Environ. Pollut. Health Hazard 3, 27-42 (1990).

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3. Vinay S.D., Raghu K.G., Kodi R.B., Vijayalakshmi K., Babu C and Sood P.P: Glycosidases inhibition in methylmercury vis-à-vis myelin degeneration. A biochemical and electron microscopic study. Environ. Concern. Tissue Injury 4, 67-75 (1990).
4. Raghu K.G., Vinay S.D. and Sood P.P: Mitochondrial injury and succinic dehydrogenase inhibition with acute dose of methyl mercury: A biochemical and electron microscopic study of central nervous system. Environ. Concern. Tissue Injury, 4, 205-211 (1990).
5. Vinay S.D., Raghu K.G., and Sood P.P: Efficacy of thiol compounds in the reversal of methyl mercury inhibited central nervous system glycosidases, Environ, Contam, and Hygen. . 51-14 (1990).
6. Sood P.P., Raghu K.G., Babu C., Kodi R.B., Vijayalakshmi K and Vinay S.D: Electron microscopic and biochemical evaluation of cellular susceptibility due to methyl mercury poisoning in relation to protein synthesis. Environ. Conam. Hygen. 5, 15-20 (1990).
7. Vinay S.D., Raghu K.G., and Sood P.P: An assessment of methyl mercury evoked behavioural changes in rat and its chelation therapy. Man. Sci. Environ. 123-137 (1994).

### Papers in conference proceedings

Vinay, S.D., Raghu K.G. and Sood, P.P: An assessment of chelating agents therapy in the restoration of methyl mercury inhibited enzymes in different areas of central nervous system of rat. Proceed. Natl. Symposium Physiol. Human. Perform. Delhi 133-148 (1987).

## PRESENTATIONS

### Invited talk

1. High glucose mediated change in redox homeostasis and mitochondrial dysfunction in H9C2 cells, 9th annual meeting of Indian academy of biomedical sciences. Kolhapur, 27th – 29th Feb. 2020
2. Hyperglycemia induce apoptosis via change in polyol pathway and mitochondrial dysfunction in H9C2 cells, 17th Annual Meeting Of The Society For Free Radical Research-India, Mumbai 12-15th Feb. 2020
3. Science behind prevalence of metabolic syndromes in Kerala, Fr. Issac Endowment Lecture, Christ college Irinjalakuda, 24th Feb. 2020
4. Significance of mitochondria & endoplasmic reticulum in the genesis of MS, National Conference on Biotechnology Innovation: Interdisciplinary Approach to Agriculture, Food, Health, Environment and Sustainable Development (NatConBio-2019), Lucknow Sept 26-28, 2019

## Bio-Data

5. Role of mitochondria in the genesis of metabolic syndromes, St Joseph College, Irinjalakuda, 30th Jan.2019
6. Metabolic syndromes in India, Vimala College Trichur, 30th Jan.2019
7. Role of mitochondria in the genesis of various diseases. Inter National Seminar Exploring New Horizons in Medical Research "ENHIMeR" Department of Zoology, KKTU Govt College , Kodungallur, 17th January 2019
8. Mitochondria in the genesis of insulin resistance in adipocytes,7th Annual meeting of IABS, Sher-i-Kashmir Institute of Medical Sciences 20-22 Feb,2018.
9. Research on diabetes: Where do we stand? International Conference on Advances in Degenerative Diseases and Molecular Interventions at Annual meeting of SDD, 24 -25<sup>th</sup> November 2017, Hycinth Sparsa, Trivandrum.
10. *Aerva lanata* improves insulin sensitivity via down regulation of lipogenic in high energy diet rat model, International Conference on Diabetes and Phytotherapy, 18.08.2017 to 20.08.2017 2017, Biochemistry department, Annamalai University, Tamilnadu.
11. Punicic Acid: A Potential Nutraceutical For Diabetes And Associated Complications at International Conference On Nutraceuticals And Chronic Diseases, 1-3, September 2017, Goa.
12. Mitochondrial biology, at workshop to deliberate and formulate new concepts on Interdisciplinary Principles in Modern Biology, 21<sup>st</sup> to 23<sup>rd</sup> of February, 2017,Zoology dept, Kerala University, Karivattom.
13. Mitochondrial Dysfunction in H9C2 Cells during Ischemia and Amelioration with *TribulusterrestrisL* at Annual Meeting of FRRS of Indian section 7-9 January 2016, College of Medicine & JNM Hospital, Kalyani ,West Bangal.
14. Hydroxycitric Acid from Garcinia Species is a Potent Nutraceutical against ER Stress Associated Complications in Pre-adipocytes at International Conference on Nutraceuticals and Chronic Diseases, 9<sup>th</sup> to 11<sup>th</sup> September, 2016, Cochin, Kerala.
15. Bilobalide Safeguards 3T3-L1 Adipocytes From Hypoxia Through Protecting Mitochondrial Bioenergetics, Biogenesis And Dynamics, International Conference on Oral and Maxillofacial Surgery (ICOMS) Seoul South Korea Sept 1-3, 2016.
16. Mitochondria: Potential Target For Drug Discovery at Recent development in drug discovery, Recent Development in Biotechnology and Pharmaceuticals, 30<sup>th</sup> January 2016, Govt. Pharmacy College, Trivandrum.
17. *Boerhaavia diffusa*: A Potential Nutraceutical for Heart Health at Annual Meeting of SBTI, 19-21<sup>st</sup> October 2016, NIOT, Chennai.

## Bio-Data

18. ER Stress: An Emerging Target For Drug Discovery For Metabolic Syndromes at International Conference on Environmental Conservation and Human Health – Challenges and Strategies (ICECH – 2016), 21-23 December, 2016, S V University ,Tirupati.
19. Hydroxycitric Acid from Garcinia Species is a Potent Nutraceutical against ER Stress Associated Complications in Pre-adipocytes, an International Conference on Nutraceuticals & Chronic Diseases, 9 -11 September 2016, Cochin.
20. Plants as potential resources for drug development, St Thomas college, Trichur, 7 to 9th Oct.2015
21. Recent Advances in Research and Treatment of Human Diseases and 4<sup>th</sup> Annual Meeting of Indian Academy of Biomedical Sciences, January 9-11, 2015.,IICT , Hyderabad.
22. Mitochondria: Potential target for drug discovery, Annual meeting of SBTI on 17-19 December 2015, at Lakeshore Hospital, Ernakulam.
23. Plants: Potential resource for drug discovery at meeting of Insight into Recent trends in Biological Sciences and Technology, Botany Department University College, Trivandrum, 29-30 September, 2015.
24. Traditional medicine: Potential resource for NCE for diabetes, at MED CHEM 15,29–30 October 2015, IIT, Chennai.
25. *Symplocos cochinchinensis*: A potential medicinal plant for Diabetes. Evidence from in-vitro and in-vivo study. National Conference on Modern Trends in Zoological Research, P G Department of Zoology, St. Aloysius College, 25 - 26 March 2014, Thrissur.
26. PPAR modulators from plants, International conference on Genomics and Proteomics (ICGP-2012), NIT Calicut. 14-16th July 2012,
27. Anti-oxidant phytochemical as a potential nutraceutical for control and management for diabetes. International Conference on Multidisciplinary Approaches to Diabetes Research and Health 14 16 November, 2010, Department of Zoology, Rajasthan University Jaipur.

## AWARDS AND HONORS

- S.S. Parmar Foundation Research Prize awarded by Indian Academy of Neuroscience. Hari Ohm Ashram Perit Bhaika Inter University, Smarak Trust Award by Sardar Patel University, India for best publication.
- The article entitled “Characterization of cytotoxicity induced by arsenic trioxide (a potent anti-APL drug) in rat cardiac myocytes” appeared in Journal of Trace Elements in Medicine and Biology, Volume 23, Issue 1, January 2009, Pages 61-68 had been selected as one among TOP 25 hottest articles
- CSIR (Govt. of India) Technology Award (2009) for the development of synthetic endoperoxide antimalarials as substitute to artemisinin derivatives (As team member).

## Bio-Data

- Co Investigator of a presentation entitled “studies on biosynthetic hydrogels for tissue engineering - effect of free water on cell penetration and survival grade Injectable scaffold which had been adjudged for young scientist award in Kerala science congress in 2011.

### Achievements and awards of my research group (PhD students & PDFs)

- 1 Riya M P got best oral presentation prize during 5th World Congress of Diabetes India 2013 held at Cochin on 18-21 April, 2013 (Riya M P & Raghu KG).
- 2 Riya Mariam Philip has been awarded with best oral presentation prize during 5th World Congress of Diabetes India 2013 held at Cochin on 18-21 April, 2013.
- 3 Dr.Vandana Sankar (PDF) received Young Scientist Award (2014) Constituted By Kerala State Council For Science &Technology & Environment, Govt.of Kerala.
- 4 Dr.Priyanka A has been selected for poster presentation award during International conference on “Phytochemicals in Health and Disease: Challenges and Future Opportunities (ICPHD-2013) held at Annamalai University on January 23-25, 2013 (Priyanaka A & Raghu KG).
- 5 Dr.Soumya R.S has been selected for Travel Grant Award on the basis of oral presentation during International Conference on Bioactive Phytochemicals and Therapeutics (ICBPT-2013) held at Annamalai University on April 05-07, 2013. (Soumya R.S & Raghu KG)
- 6 Ms. Kavitha Sasidharan won Naranjan S Dhalla Award for best poster presentation at Indo Canadian Symposium on Heart Failure: Progress & Prospects, held at RGCB, Trivandrum on 12-14 March 2015( Kavitha Sasidharan & Raghu.K.G).
- 7 Ms. Reshma P.L won first prize in poster presentation at International Academy of Cardiovascular Sciences (IACS) during 7th International conference on ‘Recent Advances in Cardiovascular Sciences’ at Amity University, Noida on 10-11 March 2015 (Reshma P.L & Raghu.K.G).
- 8 Dr.Shyni G L got best Poster presentation award at ‘MEDCHEM-2015, International Conference cum Workshop on Anti-diabetic Drug Discovery and Development’, held at IIT-Madras, Chennai, Oct 2015 (Shyni G. L & Raghu.K.G).
- 9 Dr.Shyni G L IBS Award for best paper presentation on Medical biotechnology at ‘Annual meeting of Society for Biotechnologists (India)’ held at lakeshore Hospital and Research Centre, Cochin, Kerala, Dec 2015 (Shyni G. L& Raghu.K.G).
- 10 Dr.Shyni G. L got Travel award for poster presentation at “International Conference on Recent Advances in Research & Treatment of Human Diseases” held at Hyderabad from 9th January 2015 to 11th January 2015. (Shyni G. L & Raghu.K.G).
- 11 Mr. Salin Raj got young scientist award at International Conference on Nutraceuticals & Chronic Diseases held at Cochin, Kerala from September 9-11 2016( Salin Raj & Raghu.K.G).
- 12 Preetha Rani.M.R got best oral presentation award at International Conference on Nutraceuticals & Chronic Diseases held at Cochin, Kerala from September 9-11 2016 (Preetha Rani.M.R & Raghu.K.G).
- 13 Dr.Shyni.G.L got best oral presentation award at International Conference on Nutraceuticals & Chronic Diseases held at Cochin, Kerala from September 9-11 2016 (Shyni.G.L & Raghu.K.G).
- 14 Swapna Sasi U.S has been selected for poster presentation award during International conference on “Diabetes and Phytotherapy (ICDP-2017) held at Annamalai University on August 18-20 2017 (Swapna Sasi U.S & Raghu.K.G).
- 15 Preetha Rani.M.R got best oral presentation award at International Conference on Nutraceuticals & Chronic Diseases held at Goa, from September 1-3 2017 ( Preetha Rani M.R & Raghu.K.G).

## Bio-Data

- 16 Anupama Nair got best oral presentation award at International Conference on Nutraceuticals & Chronic Diseases held at Goa, from September 1-3 2017 (Preetha Rani M.R & Raghu.K.G).

### VARIOUS PROJECTS COMPLETED & ONGOING

1

Title of project	Proprotein Convertase Subtilisin/Kexin type-9 (PCSK-9) inhibitors from <i>Garcinia cambogia</i>
Funding agency & amount sanctioned	DHR- Rs. 44.45 Lakhs
Participants	Shyni GL as PI (CSIR NIIST)
My role	Mentor
Duration & period	3 years, 2018 -2021

2

Title of project	Development of novel leads for anti-obesity from North East traditional system through chemistry biology interphase
Funding agency & amount sanctioned	DBT -Rs.32.00 Lakhs
Participants	CSIR NIIST
My role	PI
Duration & period ration & period	3 years, 2018 -2021

3

Title of project	Development of guar gum nanoparticle based mitochondrial antioxidants for cardiac hypertrophy.
Funding agency & amount sanctioned	DHR- Rs. 30 Lakhs
Participants	Soumya R S as PI (CSIR NIIST)
My role	Mentor
Duration & period	3 years, 2019 to 2022,

4

Title of project	Significance of mitochondrial associated ER membrane in diabetic cardiomyopathy”
Funding	DHR- Rs. 31 Lakhs



## Bio-Data

agency & amount sanctioned	
Participants	Anupama Nair as PI (CSIR NIIST)
My role	Mentor
Duration & period	3 years, 2019 to 2022,

5

Title of project	Development of biflavonoid based lead molecule (NIIST-OBT-2) from <i>Garcinia travancorica</i> for non-alcoholic fatty liver disease (NAFLD)
Funding agency & amount sanctioned	DHR- Rs. 42.23 Lakhs
Participants	Sindhu G as PI (CSIR NIIST)
My role	Mentor
Duration & period	3 years, 2018 to 2021,

6

Title of project	Development and In-Vitro characterization of Rare earth phosphate coatings for biodegradable and biocompatible magnesium based temporary implants"
Funding agency & amount sanctioned	ICMR ( PI Dr.Srinivasan ) 47,20,796/-
Participants	CSIR NIIST
My role	Co-PI
Duration & period	3 years

7

Title of project	Development and in vitro characterisation of magnesium alloys for biocompatible and biodegradable implant application.
Funding agency & amount sanctioned	SERB ( PI Dr.Srinivasan A ) 42,38,455/-
Participants	CSIR NIIST
My role	Co-PI
Duration & period	3 Years 2018-2021

### Completed Projects

8

## Bio-Data

Title of project	Biocompatible Combined Polymer Polysaccharide Core-Shell VEGF-Targeted Nano-Carrier for Sustained Intraocular Pharmacotherapy Towards Diabetic Retinopathy.
Funding agency & amount sanctioned	DBT (PI Dr. Kaustabh Kumar Maiti (CSIR-NIIST) 51,23,200/-
Participants	CSIR NIIST, Thiruvananthapuram
My role	Co-Investigator
Duration & period	3 years ,6/09/2018-5/0/2021

9

Title of project	Evaluation of beneficial effect of Boeravinone - B from Boerhaavia diffusa against diabetic cardiomyopathy through mitochondria mediated pathway in H9c2 cardiomyoblast and heart for development of nutraceutical .
Funding agency & amount sanctioned	DHR Rs.30 Lakhs
Participants	Salin Raj P as PI (CSIR NIIST)
My role	Mentor
Duration & period	3 years, 2017 to 2020

10

Title of project	Bioprospection of plant resources and other natural products (BioprosPR
Funding agency & amount sanctioned	CSIR Rs. 30.64 lakh
Participants	NBRI, CDRI, IITR, IHBT, CIMAP, NIIST
My role	Nodal Officer from CSIR NIIST Trivandrum
Duration & period	5 years, 1/04/2012 to 31/03/2017

11

Title of project	New Approaches towards Understanding of Disease Dynamics and to Accelerate Drug Discovery.
Funding agency & amount sanctioned	CSIR Rs. 61.78 lakhs
Participants	CDRI, IICT, NIIST
My role	Nodal Officer from CSIR NIIST Trivandrum
Duration & period	5 years, 1/04/2012 to 31/03/2017

12

Title of	Towards holistic understanding of Complex Diseases: Unraveling the Threads
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## Bio-Data

project	of Complex Diseases
Funding agency & amount sanctioned	CSIR Rs. 77.56lakhs
Participants	CDRI, IICT, CCMB, IGIB
My role	Nodal Officer from CSIR NIIST Trivandrum
Duration & period	5 years, 1/04/2012 to 31/03/2017

13

Title of project	Natural Products as Affordable Health care Agents (NAPAHA)
Funding agency & amount sanctioned	CSIR Rs. 570.27 lakh only
Participants	CDRI, IICT, NCL,CCMB,IHBT
My role	Nodal Officer from CSIR NIIST Trivandrum
Duration & period	5 years, 1/04/2012 to 31/03/2017

14

Title of project	Design a smart drug-delivery system using cell penetrating peptides and scaffold- based non peptide carriers for targeting human cancer
Funding agency & amount sanctioned	DST Rs 27.00 Lakhs
Participants	CSIR NIIST (K Maithi as PI)
My role	Co-Investigator
Duration & period	- 1st June, 2013 to 31st May 2016

15

Title of project	Phenolic compounds from Centella asistica, Boerhavia diffusa and Desmodium gangeticum as protectors against arsenic trioxide (A potent anti-APL drug) induced cardiotoxicity: An in vitro cell lines based approach
Funding agency & amount sanctioned	ICMR Rs. 14 lakhs
Participants	CSIR NIIST
My role	PI
Duration & period	15-01-2011 to 14-01-2013

**BROAD AREAS OF RESEARCH**

## Bio-Data

- ✓ Basic biology of cardioetabolic syndromes (CVD, Diabetes, Obesity, NAFLD)
- ✓ Leads generations from traditionally known medicinal plants for metabolic syndromes

### INVOLVEMENT IN COLLABORATION WITH OTHER RESEARCH INSTITUTES

- ✓ Biochemistry Department, University of Kerala, Trivandrum
- ✓ Jubilee Mission Medical College & Research Centre, Trichur
- ✓ Jawaharlal Nehru Tropical Botanic Garden & Research Institute, Palode, Thiruvananthapuram
- ✓ Central Drug Research institute, Lucknow, UP
- ✓ North East Institute of Science and Technology, Jorhat, Assam

### FOREIGN VISIT

- ✓ Visited Seoul, South Korea for delivering invited talk at annual meeting of Korean society of obesity at 2015
- ✓ Visited France as a member of high level delegate of Indian Contingent for exploring bilateral collaboration at 2019

### ADMINISTRATIVE EXPERIENCE

- ✓ Worked as Head of Agroprocessing and Technology Division consisting of 11 scientists,3 technical officers and 45 research students (from April 2018-March 2021)
- ✓ Chairman , Works Committee, CSIR NIIST-Since March,2018 continuing
- ✓ Chairman, Utility Committee- CSIR NIIST continuing Since March,2018 continuing
- ✓ Chairman, PhD students selection Committee of AcSIR ,NIIST campus (Biology Stream),continuing
- ✓ Director's nominee for doctoral advisory committee of PhD students- continuing
- ✓ Chairman, selection committee of project students (Biology stream)
- ✓ Institutional nodal officer, health care theme of CSIR

## Bio-Data

- ✓ Member, scientist selection committee of CSIR NIIST
- ✓ Acted as member of academic programme committee of institute (2010-2012)
- ✓ Acted as member of Rajabasha promotion committee (2010-2012)
- ✓ Acted as assistant coordinator for conducting national eligibility test for JRF and lectureship examination ( 2015 and 2016)

## PERSONAL PARTICULARS

- Sex: Male
- Age & Date of Birth: 59 years, 05-12-1962
- Nationality: Indian
- Address

Permanent:

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## REFEREES

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Emeritus Professor

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# Bio-Data

## Declaration

I hereby declare that all the statements made in this CV of me are true to the best of my knowledge and belief.

Place: Thiruvananthapuram

Date: 27/09/2021



(K. G Raghu)

## SUMMARY OF RESEARCH ACTIVITIES

I and my group are actively working on the basic biology of metabolic syndromes and associated complication for last two decades. Research on various bioactives from medicinal plants reported in Indian system of medicine for lead generation via reverse pharmacology approach against diabetes/CVD/obesity/NAFLD is also our interest. Some of the important research of our group are listed below:

I have developed various in vitro models for cardiovascular diseases; diabetes and non-alcoholic fatty liver diseases for mechanism based studies and thereby leads generations. In the area of diabetic cardiomyopathy (DCM), my group reported calcium overload in cardiac myocytes during hyperglycemia via impairment of SERCA/PLN pathway and mitochondrial dysfunction. This leads to oxidative stress in cardiac cells (PMID: 30739350). Surplus glycation and PKC  $\alpha$  down regulation during hyperglycemia have also been reported by our group (PMID: 29477910). In addition hyperglycaemia induced apoptosis in H9c2 cells via alteration in redox homeostasis linked mitochondrial dynamics and polyol pathway reported by our group will have significant role in designing therapeutic strategies against DCM in future (PMID: 30144576). We also identified certain proteins such as AGER1, RAC1, Bip/GRP78 in the heart with critical role in the development of DCM in rat (unpublished data). Importance of inflammation in the development of insulin resistance during hypoxia in adipocytes is an exciting study from our group for prophylactic management of diabetes (PMID: 29180021). Importance of ER stress in the genesis of insulin resistance has been established and this is found to be a new area for drug discovery for diabetes (PMID: 25175938).

## Bio-Data

Our extensive work on medicinal plant extracts, phytochemicals and their therapeutic potential against diabetes, CVD and associated complications have identified good number of leads for future research. We found that *Tribulus terrestris* L. fruit ameliorates ischemic insult in H9c2 cells by safeguarding mitochondrial function. This validates the use of *T. terrestris* L. against heart disorders (PMID: 30841448). *Boerhaavia diffusa* against cardiac hypertrophy are found to be very interesting. The effectiveness of *Boerhaavia diffusa* in attenuating apoptosis in cardiac cells, which is a major contributor to sudden cardiac death during cardiac hypertrophy, is an exemplary one (PMID: 30372810). In one of our study apigenin, (-)-hydroxycitric acid and quercetin were found to ameliorate mitochondrial

Alterations by tunicamycin-induced ER stress in adipocytes (PMID: 25106896). Bilobalide was found to attenuate hypoxia induced oxidative stress, inflammation, and mitochondrial dysfunctions via its antioxidant potential (PMID: 25039303). We reported the antidiabetic property of *Symplocos cochinchinensis* through its insulin sensitizing activity and down regulating lipogenesis in high energy diet rat model (PMID 27686268). Similarly, chebulagic acid from *Terminalia chebula* is found to enhance insulin mediated glucose uptake in adipocytes via PPAR $\gamma$  signaling pathway (PMID: 25529897). My group also worked on phloretin to check its potential to ameliorate arsenic trioxide induced mitochondrial dysfunction in H9c2 cardiomyoblasts mediated via alterations in membrane permeability and ETC complexes. This is an exciting study, found to have high relevance to oncology (PMID: 25746422). We has also contributed in the area of nanoparticles for biomedical application especially for cardiovascular diseases. Our group have synthesized, characterized and evaluated the antioxidant potential of vanadium encapsulated guar gum nanoparticles and found ideal for biomedical application as antioxidant supplement (PMID: 24463743). In addition, selenium incorporated guar gum nanoparticles prepared by them was found to safeguard mitochondrial bioenergetics during ischemia reperfusion injury in H9c2 cardiac cells (PMID: 25307064).

A series of cardiovascular complications associated with hyperglycemia is a critical threat to the diabetic population. Here we elucidated the link between hyperglycemia and cardiovascular diseases onset, focusing on oxidative stress and associated cardiac dysfunctions. For this both in vitro and in vivo models have been standardized in our lab for mechanism based studies. Detailed investigations were conducted on free radical generation, alterations in innate antioxidant system, lipid peroxidation, AGE production, PKC  $\alpha$  ERK signaling pathway, mitochondrial function etc. Hyperglycemia has significantly enhanced reactive oxygen species generation, depleted activity and expression of enzymes particularly CuZnSOD (SOD1) and MnSOD (SOD2), increased production of AGE. Besides, PKC  $\alpha$  dependent ERK signaling

## Bio-Data

pathway was found activated leading to cardiac dysfunction. The outcome of this preliminary study reveals the importance of integrated approach emphasizing redox status, glycation and signaling pathways like PKC  $\alpha$  - ERK axis for control and management of diabetic cardiomyopathy (PMID: 29477910).

Thereafter the role of alterations in redox homeostasis in the induction of apoptosis during hyperglycemia in the cardiac cells via dysfunction in mitochondria and polyol pathway were studied. Alterations in the innate antioxidant system, polyol pathway, mitochondrial integrity, dynamics and apoptosis were investigated. Hyperglycemic insult has significantly affected redox homeostasis. It also caused dysregulation in mitochondrial dynamics (fusion, fission proteins), dissipation of mitochondrial transmembrane potential and increased sorbitol accumulation. Finally, apoptosis was observed with upregulation of Bax, activation of caspase-3 and downregulation of Bcl-2 (PMID: 30144576). We also elucidated the mechanisms by which hyperglycemia induce alteration in calcium homeostasis. Intracellular calcium ( $[Ca^{2+}]_i$ ) overload was found increased significantly with HG. For elucidation of mechanism, the SERCA pathway and mitochondrial integrity were explored. Then, we assessed oxidative stress, and cell injury with brain natriuretic peptide (BNP), atrial natriuretic peptide (ANP), and lactate dehydrogenase (LDH) release. HG caused significant  $[Ca^{2+}]_i$  overload through downregulation of SERCA2/1, pPLN, and pPKA C- $\alpha$ ; and upregulation of PLN. The  $[Ca^{2+}]_i$  overload in turn caused oxidative stress via generation of reactive oxygen species, lipid peroxidation, and protein carbonylation. This resulted in cell injury which was evident with significant release of BNP, ANP. From the overall results, we conclude that  $[Ca^{2+}]_i$  overload via SERCA pathway and altered mitochondrial integrity is the main cause for oxidative stress during HG (PMID: 30739350). This study reveals the cross talk between redox status, mitochondria and calcium homeostasis play very important role in the genesis of diabetic cardiomyopathy.

Another study in the area of ethanopharmacology we found that pre-treatment with *Alpinia Galanga* extract (AGE) downregulated the release of pro-inflammatory mediators (IL-6, TNF- $\alpha$ , NO, and ROS) and stimulated the release of anti-inflammatory mediator IL-10 in LPS stimulated RAW 264.7 cells. The vital enzymes of inflammation (iNOS, COX-2, and MMP-9) were also downregulated by pre-treatment with AGE. AGE targeted the upstream elements of the inflammatory cascade by blocking LPS induced activation of TLR4 and JAK/STAT pathway. The phosphorylation of downstream kinases was significantly affected. The inhibition of nuclear translocation of NF- $\kappa$ B further confirmed the specific inhibition of the TLR4 pathway. Particularly AGE inhibited the phosphorylation of JNK, p38, I $\kappa$ B $\alpha$ , and STAT. HPLC analysis of the AGE showed the polyphenol-rich nature of the extract. This study is found to be highly



## **Bio-Data**

relevant in the development of phytopharmaceuticals against inflammatory disorders like rheumatoid arthritis ( PMID: 33887419)

### **CONTRIBUTION IN TRANSLATION RESEARCH**

During my service at CSIR- CDRI, Lucknow Compounds CDRI 97/78 and CDRI 99/411 have been developed as an antimalarial drug and CDRI 99/373 as antiosteoporosis agents. CDRI-134-F0194 has been developed as an herbal formulation for bone health. My contribution was the evaluation of cardiac QT prolongation potential of these compounds via classical microelectrode technique (current clamp)- An essential requirement before pre-clinical trial. CDRI 97/78 and CDRI 99/411 have now been transferred to IPCA.

