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Research area

Isolation of biomolecules from Moringa seed and studying their health benefits: Our research activities involve isolation of biomolecules from oilseeds and studying their biological activities. My group is working on various aspects of moringa seeds since 2009. Crude extract of Moringa seeds has shown to have many health benefits. Identification of specific biomolecule(s) from moringa seeds and its evaluation against specific disease(s) will be of great national importance. Presently we are involved in the isolation, purification and characterization of proteins, peptides, carbohydrates and polyphenols with an objective to study the antihypertensive and hypocholesterolemic properties of moringa seed.

Water purification technology using *Moringa oleifera* seed flour: India is one of the largest producers of moringa seed and the moringa seed cake obtained after oil extraction is exported at a low price. Moringa seed flour is well known for its water purification and antimicrobial properties. From the literature, it is visible that in spite of its well documented water purification capacity, bacterial contamination of the moringa seed treated water limits its use. We have developed a technology for water purification using moringa seed protein as a flocculant and released to industries.

Ongoing Research

1. Isolation of biomolecules from plant extracts and studying their health benefits with special reference to *Moringa oleifera*
2. Purification of water using moringa seed protein
3. Structural stability of enzymes and proteins
4. Physico-chemical and functional properties of oilseed proteins
5. Enzymatic and physical modification of proteins for better functionality and nutrition

Major areas of expertise

1. Isolation and characterization of biomolecules.
2. Biophysical studies of proteins and enzymes
3. Purification and characterization of proteins
4. Preparation and characterization of protein hydrolysates from plant/animal proteins

Honours and Awards

1. Felicitation at 1st DBT-Bio-CARe Conclave: Women Scientists Achieving Great Heights. Organized by Department of Biotechnology and National Institute of Plant Genome Research, New Delhi, March 2019.
2. CSIR CFTRI Best Technical Contribution Award for the year 2016-17 in the area of Protein Chemistry and Technology.
3. Bio-CARe Award from DBT, Government of India. DBT has awarded a project worth Rs.33.71 Lakhs for a period of 4 years and a Honorarium of Rs.10,000 per month.
4. Shree Haveliram Pasrich Prize 2004
5. CSIR Best Poster Award 2004

Research grants

1. Use of Moringa seed flour as a potential source for water purification. Ministry of Drinking Water and Sanitation. (GAP 467), **Principal Investigator**, Rs.24.84 Lakhs.
2. Isolation of biomolecules from Moringa seeds and studying its health benefits. DBT Bio-Care Project. (GAP 397) **Principal Investigator**. Rs.33.37 Lakhs.
3. High protein low calorie butter spread. MLP 0127, **Principal Investigator**. Rs.6.00 Lakhs.
4. Debittering of Moringa seed cake, Private Industry, Tamil Nadu, (SSP 164). **Project Leader**: Rs.2.26 Lakhs.

Ph.D Programme

Recognized guide for Ph.D under AcSIR, CSIR CFTRI, Mysore

Teaching Experience

Faculty for M.Sc Food Technology conducted by CFTRI

Faculty for different short term training courses in the area of Protein Chemistry and Technology.

Project Students Guided

Mr Romuald Willy Saa, **CSIR-TWAS** fellow for his Ph.D on Influence of three technological treatments (soaking, germination and roasting) on the physicochemical, functional and nutritional properties of *Moringa oleifera* seeds.

Sri Sandanamudi Anudeep, **DBT Project SRF**

Ph.D on *Moringa oleifera* seed soluble fibre: its prebiotic and hypocholesterolemic implications.

Sri Ankit Jain, **MDWS Project JRF**: Water purification using moringa seed protein for Ministry of Drinking Water and Sanitation, New Delhi.

Sri Kishan Bharadwaj, **MDWS Project JRF** Ministry of Drinking Water and Sanitation, New Delhi. Water purification using moringa seed protein

Ms. Komal, **MDWS Project JRF**, Ministry of Drinking Water and Sanitation. Use of Moringa seed flour as a potential source for water purification

Sri Darshan C.M., **MDWS Project JRF** Ministry of Drinking Water and Sanitation, New Delhi. Water purification using moringa seed protein

MSc/M.Tecch/B.Tech students guided: 19 Nos.

Prospective post doctoral fellows with fresh PhD (submitted or awarded) can contact (radha@cftri.res.in) directly with their CV, updated publication list and research interest. Funding opportunities for post-doctoral fellowships can be explored after discussion with the candidate.

Publications – 26

1. Ankit Jain, Subramanian, R., Manohar, B. and Radha, C. (2019). Preparation, characterization and functional properties of Moringa oleifera seed protein isolate. J. Food Sci. Technol. <https://doi.org/10.1007/s13197-019-03690-0>
2. Anudeep S, Radha C. (2018). Carbohydrates of *Moringa oleifera* seeds. *International Journal of Research and Analytical Reviews*, 5:103-108.

3. Swetha, M.P., Radha, C. and Muthu Kumar, S.P. (2018). Bioaccessibility and bioavailability of *Moringa oleifera* seed flour polyphenols. *Journal of Food Measurement and Characterization*. Online. doi.org/10.1007/211694-018-9806-4.
4. Swetha, M.P., Radha, C and Muthu Kumar, S.P. (2018).Effect of bound phenolic from defatted *Moringa oleifera* seed flour on diet induced hypercholesterolemic mice. *Journal of Food Biochemistry*. DOI: [10.1111/jbc.1253](https://doi.org/10.1111/jbc.1253)
5. Sandanamudi Anudeep, Vaddi K. Prasanna, Shruthi M. Adya, Cheruppullil Radha (2016). Characterization of soluble dietary fiber from *Moringa oleifera* seeds and its immunomodulatory effects. *International Journal of Biological Macromolecules*, 91 (2016),656-662. [doi:10.1016/j.ijbiomac.2016.06.013](https://doi.org/10.1016/j.ijbiomac.2016.06.013)
6. Anudeep Sandanamudi, Kishan R. Bharadwaj, Radha Cheruppanpullil, Data for chitin binding activity of *Moringa* seed resistant protein (MSRP), *Data in Brief*, **9**, 335–337, 2016. DOI: 10.1016/j.dib.2016.08.070
7. Radha C., Ogunsina B.S. , Hebina Babu K.T (2015).. Some Quality and Micro-structural Characteristics of Soup Enriched with Debittered *Moringa Oleifera* Seeds Flour. *American Journal of Food Science and Technology*, **3(6)**, 145-149
8. Indu Vasudevan, Ankit Jain, Radha Cheruppanpullil (2015) Evaluation of antioxidant activity of soluble and bound phenolics from groundnut (*Arachis hypogaea* L.) *International Journal of Engineering & Scientific Research*, **3,(3)**, 76-98
9. Ankit Jain, Maya Prakash and C.Radha , (2015) Extraction and evaluation of functional properties of groundnut protein concentrate.*J Food Sci Technol* , **52 (10)**, 6655-6662
10. Vishwanath S Vallabha, T. N. Indira, A. Jyothi Lakshmi, C. Radha, Purnima Kaul Tiku (2015) Enzymatic process of rice bran: a stabilized functional food with nutraceuticals and nutrients, *J Food Sci Technol*. DOI 10.1007/s13197-015-1926-9
11. Govardhan Sing, R.S., Negi, P.S. and Radha, C. (2013). Phenolic composition, antioxidant and antimicrobial activities of free and bound phenolic extracts of *Moringa oleifera* seed flour. *Journal of Functional Foods*, **5**, 1883-1891.

12. Ogunsina, B.S., Bhatnagar, A.S., Indira, T.N. and Radha, C. (2012). The Proximate composition of African bush mango kernels (*Irvingia gabonensis*) and characteristics of its oil. *Ife Journal of Technology*, **14**(1), 177-183.
13. Ogunsina, B.S., Indira, T.N., Bhatnagar, A.S., Radha, C., Debnath, S., and Gopalakrishna, A.G. (2011). Quality characteristics and stability of *Moringa oleifera* seed oil of Indian origin. *Journal of Food Science and Technology. Online*
14. Govardhan Singh, R.S., Ogunsina, B.S. and Radha, C. (2011). Protein extractability from defatted *Moringa oleifera* Lam. Seeds flour. *Ife Journal of Science*, **13**(1), 121-127.
15. Ogunsina, B.S., Radha, C. and Indrani, D. (2011). Quality characteristics of bread and cookies enriched with debittered *Moringa oleifera* seed flour. *Int. J. Food Sci. Nutr.* **62**(2), 185-194.
16. Ogunsina, B.S. and Radha, C. (2010). Comparative study of the functional and physico-chemical properties of debittered moringa seeds and soybeans flours. *Ife Journal of Technology*, **19**(1), 85-92.
17. Ogunsina, B.S., Radha, C. and Govardhan Singh (2010). Physicochemical and functional Properties of full fat and defatted *Moringa oleifera* kernel flour. *International Journal of Food Science & Technology*, **45**, 2433-2439.
18. Radha, C. and Prakash, V. (2009). Structural and functional properties of heat-processed soybean flour: Effect of proteolytic modification. *Food Science and Technology International*, **15**, 453-463.
19. Ujawal Hegde, Jyothi Lakshmi, A., Radha, C., Ramesh Kumar, P. and Jamuna Prakash (2009). Effect of soya protein on the dialysability of exogenous iron and zinc. *Food Chemistry*. **117**, 577-581.
20. Radha, C., Ramesh Kumar, P. and Prakash, V. (2008). Enzymatic modification as a tool to improve the functional properties of heat processed soy flour. *Journal of the Science of Food and Agriculture*. **88**, 336-343.
21. Radha, C., Ramesh Kumar, P. and Prakash, V. (2008). Preparation and characterization of a protein hydrolysate from an oilseed flour mixture. *Food Chemistry*, **106**, 1166-1174.
22. Bhaskar, N., Benila, T., Radha, C. and Lalitha, R.G. (2008). Optimization of enzymatic hydrolysis of visceral waste proteins of Catla (*Catla catla*) for preparing protein hydrolysate using a commercial protease. *Bioresource Technology*, **99**, 335-343.

23. Rhicha Sinha, Radha, C., Jamuna Prakash and Purnima Kaul. (2007). Whey protein hydrolysate: Functional properties, nutritional quality and utilization in beverage formulation. *Food Chemistry*, **101**, 1484-1491.
24. Bhaskar, N., Modi, V.K., Govindaraju, K., Radha, C. and Lalitha, R.G. (2007). Utilization of meat industry by products: Protein hydrolysate from sheep visceral mass. *Bioresource Technology*, **98**, 388-394.
25. Radha, C., Muralidhara B.K., Kumar P.R., Tasneem Rand Prakash, V. (1998). Thermal stabilization of the multimeric proteins – A case study with alpha globulin. *Indian Journal of Biochemistry and Biophysics*. 76-85.
26. Rajendran, S., Radha, C.,. and Prakash, V. (1995). Mechanism of solvent induced thermal stabilization of alpha-amylase from *Bacillus amyloliquefaciens*. *International Journal of Peptide and Protein Research*. 122-128.

Patents

International granted: 3 Nos.

Radha et al., (2006). A process for the preparation of high arginine peptides. US Patent No.7,091,001 dated August 15, 2006.

Radha, et al., (2002). A process for the preparation of a high protein hydrolysate. US Patent No.US-6420133 dated July 16, 2002.

Radha, et al, (2006). Process for the preparation of protein hydrolysate from legumes/soy flour. US Patent 7,112,424 dated September 26, 2006.

National granted/filed - 5 Nos.

Technology released to Industry

1. Process know-how for the production of soy protein hydrolysate.
2. Moringa seed protein isolate as flocculant

Process ready for commercialization

1. Process for the preparation of stabilized edible rice bran.

Research Projects- Team member

1. Development of processes for production of nutritional and functional ingredients of therapeutic value and their impact on physiological process, (MLP 087)

2. Niche food processing technologies for outreach of cost effective, safe, hygienic, nutritious and health food to the target population (SIP 002).
3. Structural insights towards understanding (a) the immunogenicity of small molecular weight proteins and (b) hypocholesteromic and anorectic activity of peptides (MLP 077)
4. Studies on enzymatic hydrolysis of four different types of proteins (SSP 135).
5. Studies on characterization of peptides obtained from protein hydrolysates (SSP 0150)
6. Development of functional foods and assessing the bioavailability of micro and macro nutrients (NNP 029)
7. Functional role of storage proteins and their utilization in product development with focus on their surface and inherent properties (MLP-021)
8. Development of polysaccharide based fat substitutes and their use in Indian food products (GAP 272)
9. Antinutritional factor analysis of cereals (CNP 221)
10. Production and availability of food grade soy meals in the market (GAP 147)
11. Utilization of proteins from inexpensive sources for enhancing surface properties (GAP 101)
12. Peptides from oilseeds (MLP 1402)
13. Scale up studies for process for (a) edible quality flour from groundnut and soybeans (b) protein hydrolysates from slaughter house wastes (MLP 1109)
14. Amino acid profiles of beverage based super granules (CNP 106: 212)
15. Peptides of commercial importance - Bioactive Biopeptides (MLP 1004)
16. Protein hydrolysate preparation from selected oilseed proteins for high functionality and use in speciality foods (MLP 0042)
17. Total technology for processing of safflower seeds (OLP 004)

18. Interaction of specific ligands with proteins, enzymes of oil bearing raw materials. Studies on determinants of protein structural stability. (FC/18/107)
19. Biophysical studies on the industrially important enzymes and proteins. (FT/512)

Papers presented in Symposia/conferences: 36

1. Juhi Aggrawal, Aswath Kumar, K., Indrani, D. and Radha, C. (2018). Preparation and Nutritional evaluation of moringa seed cookies. IFCON 2018, CFTRI, Mysore.
2. Swetha, M.P., Radha, C. and Muthukumar, S.P. (2016). Anti-hypercholesterolemic effect of defatted moringa oleifera seed cake polyphenolics. IDACON, Sept 23-25, Mumbai.
3. Janhavi, P, Radha, C. and Muthukumar, S.P. (2016). Development of non-invasive dietary hypertension in rats – Our experience. LASA 2016, Oct. 14-15, Bangalore.
4. Anudeep, S., Poornima, S. and Radha, C. (2016). Preparation, characterization and ACE inhibitory activity of Moringa seed protein hydrolysate. SBC, Nov. 21-24, CFTRI, Mysore.
5. Janhavi, P., Muthukumar, S.P. and Radha, C. (2016). In vivo antihypertensive therapeutic effect of moringa seed protein hydrolysage in fructose induced hypertensive rats. SBC, Nov. 21-24, 2016, CFTRI, Mysore.
6. Swetha, M.P., Radha, C. and Muthukumar, S.P. (2016). Bioavailability of defatted moringa oleifera seed cake bound polyphenols in Wistar rats. SBC., Nov. 21-24, CFTRI, Mysore.
7. Kishan R. Bharadwaj, Ankit Jain, Anand K. Parande, Radha C. (2016) Moringa oleifera seed protein purification and development of water purification system. Biosangam - International conference of translational Biotechnology, Feb 4-6, 2016, Motilal Nehru National Institute of Technology (MNNIT), Allahabad, UP
8. Swetha M.P, Radha C., Muthukumar S.P (2015) *In vitro* bioaccessibility and *in vivo* bioavailability of defatted moringa oleifera seed cake polyphenols. 48th Annual nutritional conference on Indian Dietetic Association – Nutrition in Transition –A Global Challenge. Nov. 19-21, 2015, Bengaluru
9. Ankit Jain, Radha, C, Subramanian, R (2014) Functionality of moringa seed protein isolate. ICFOST XXIII, Dec.13-14, 2014 NIFTEM, Haryana
10. Shruti Adya., Sandanamudi Anudeep, Prasannakumar, V and Radha, C (2014) Isolation, Purification and immunomodulatory effects of Moringa seed glycoprotein. CARBO XXIX Conference, Dec.29-31, 2014, Mohali, Punjab

11. Swetha, M.P., Radha, C. and Muthukumar, S.P. (2014) Identification and quantification of polyphenol profile from defatted *Moringa oleifera* seed cake and In vitro gastric simulation for measuring its bioaccessibility. 46th Annual National conference of Nutrition Society of India, Nov. 6-8, 2014, Dayanand Medical college and Hospital, Ludhiana, Punjab.
12. Ankit Jain, Manohar, B., Subramanian, R. and Radha, C. (2013). Factors influencing protein extractability from *Moringa oleifera* seed and optimization using Response Surface Methodology. IFCON, CFTRI, Mysore, Dec.18-21.
13. Anudeep, S. and Radha, C. (2013). *Moringa oleifera* seeds as a potential source of dietary fibre and functional oligosaccharides. IFCON, CFTRI, Mysore, Dec.18-21.
14. Swetha, M.P., Radha, C. and Muthukumar, S.P. (2013). Comparison of nutritional and polyphenol profile of Ridge guard peel and defatted *Moringa oleifera* seed cake. IFCON, CFTRI, Mysore, Dec.18-21.
15. Ankit Jain, Subramanian, R. and Radha, C. (2013). *Moringa oleifera* seed protein concentrate preparation using membrane technology. Colloquium on Food Engineering, Present status and future possibilities, CSIR CFTRI, Mysore, 6-8-2013, pp. 18.
16. Ankit Jain, Subramanian, R. and Radha, C. (2012). Hofmeister ions influence on extractant salt selection and protein isolate preparation from *Moringa oleifera* seed. Poster presented at ICFoST 2012. CFTRI, Mysore. December 6-7, 2012.
17. Govardhan singh, Pradeep, S. Negi and Radha, C. (2012). Antioxidant and antibacterial activities of free and bound phenolic extract of defatted *Moringa oleifera* seed flour. Poster presented at ICFoST 2012. CFTRI, Mysore. December 6-7, 2012.
18. Urvashi Sahu, Domendra Dhruw, Radha, C. and Muthukumar, S.P. (2012). Safety evaluation of debittered deoiled *Moringa oleifera* seed powder. An acute study. Poster presented at Jnanarjana 2012, National Conference on Bioactive compounds and therapeutics. The oxford college of science, Bangalore, February 27-28, 2012.
19. Indu, V. and Radha, C. (2011). Antioxidant activity of polyphenolics from groundnut (*Arachis hypogaea*, L.). 8th Annual meeting of the SBC, CSIR-CIMAP, Lucknow, 12-15 November 2011.
20. Ogunsina, B.S., Radha, C., and Indira, T.N. (2010). Nutritional perspectives in the utilization of *Moringa oleifera* seeds. 1st National Summit on *Moringa* development. *Moringa oleifera*: A national crop for economic growth and development. Raw Materials Research and Development Council, Nigeria. 7-8th December, 2010
21. Ogunsina, B.S., Indrani, D. and Radha, C. (2010). New perspectives in the utilization of *Moringa oleifera* seeds for local enterprise: Development of value added baked foods. International Conference on African Women and Rural Enterprise (AWARE) at Obafemi Awolowo University Conference Centre, Ile-Ife, Nigeria. Jan 25-29th, 2010,

22. Nagashree, N.A., Amit Kumar Das, Sakhare, P.Z., Sridevi A Singh, Lalitha R. Gowda, Radha, C., Bhaskar, N. and Appu Rao, A.G. (2008). Protein hydrolysates from chicken liver: Comparison of acid and enzymatic hydrolysis. 77th Annual Session and Symposium of the National Academy of Sciences, India. Novel Approaches for food and Nutritional Security, CFTRI, Mysore, Dec.6-8, 2007.
23. Radha, C., Leelavathi, K. and Prakash, V. Nutritionally improved saltine crackers using autoclaved soy flour. 77th Annual Session and Symposium of the National Academy of Sciences, India. Novel Approaches for food and Nutritional Security, CFTRI, Mysore, Dec.6-8, 2007.
24. Bhaskar, N., Benila, T., Radha, C., Reshmi, H.N. and Lalitha, R.G. Optimization of conditions for hydrolysis of fish processing waste with alcalase. 18th ICFOST 2006, Nov. 16-17, Hyderabad, India.
25. Radha, C, Leelavathi, K and Prakash, V. Effect of incorporation of defatted soy flour on the quality of saltine crackers. 36th Annual meeting of Nutrition Society of India, CFTRI, Mysore, 5-6 November 2004.
26. Radha, C. and Prakash, V. Heat induced alterations of the surface properties of soy protein. Poster presented in 5th International Food Convention, CFTRI, Mysore, 5-8 December 2003.
27. Radha, C. and Prakash, V. Tailoring vegetable proteins for desired functional attributes- A case study of soy protein. Poster presented in Dupont-CFTRI Colloquium on plant proteins. March 2003.
28. Richa Sinha, Radha, C., Jamuna Prakash and Purnima Kaul. Enzymatically hydrolyzed whey protein concentrate - Functional properties and beverage formulations. Poster presented in 15th Indian Convention of Food Scientists and Technologists, CFTRI, Mysore, December 2002.
29. Radha, C. and Prakash, V. Physical and enzymatic modification of soy flour for its use as a better functional ingredient. Poster presented in 15th Indian Convention of Food Scientists and Technologists, CFTRI, Mysore, December 2002
30. Radha, C. and Prakash, V. Effect of enzymatic modification on the Trypsin inhibitor activity of soybean flour. Poster presented in Society of Biological Chemists Symposium, Osmania University, Hyderabad, December 2001.
31. Anuradha S. Nambiar and Radha, C. Effect of detergents and enzymes on foaming capacity of proteins from vegetable sources. Poster presented in Colloquium on Vegetable Proteins, CFTRI, November 2001.
32. Radha, C. and Prakash, V. Effect of physical and enzymatic modification on the trypsin inhibitor activity of soybean flour. Poster presented in Colloquium on Vegetable Proteins, CFTRI, November 2001.
33. Radha, C. and Prakash, V. Preferential interaction of cosolvents with α -globulin, the major protein fraction from Sesame (*Sesamum indicum*, L.). Poster presented in International Food Convention (IFCON-98), CFTRI, September, 1998.

34. Sahu, R.K., Radha, C. and Prakash, V. Effect of sorbitol on the solubility and stability of α -globulin from *Sesamum indicum* L. seeds. Poster presented in society of Biological Chemists symposium, Jawarhalal Nehru University, New Delhi, Dec. 1998.
35. Radha, C. and Prakash, V. Stabilization of the structure of alpha-globulin, the major protein fraction from sesame (*Sesamum indicum*, L.) seed. Institute of Food Technologists, Annual Meeting, June 1995, Los Angeles, California, USA.
36. Radha, C. and Prakash, V. Influence of structure stabilizing solvents on the structural solubility of alpha-amylase. Poster presented in International Food Convention, AFST, September 1993, Mysore.
37. Rajendran, S., Radha, C. and Prakash, V. Mechanism of solvent induced stabilization of alpha-amylase from *Bacillus amyloliquifaciens*. Institute of Food Technologists Annual meeting, July 1993, Chicago, USA
