

Research Team:

6 Ph.D. and 2 M.S. Students, 1 Postdoctoral Research Associates, and 3 Undergraduate Students.

Ph.D. Students: Ken Over, Ronny Horax, Ilankovan Paraman, Arvind Kannan (CEMB/Food Science), Vidya Chitturi (CEMB/Food Science), Srinivas Rayaprolu.

M.S. Students Alice Donya, Dinara Tortaeva

Undergraduate Students: Brittany Adams, Mike Kaminski, Cortney Larry



5 Main Research Areas:

•Proteins

Chemistry engineering, isolation, characterization, proteomics, structure-function relationship, functionality, physicochemical properties during processing and storage, and extrusion.

The focus of protein research is on cereal (rice) and legume (soy bean and cow pea) proteins. Research includes isolation (using food grade green solvents), separation and identification (column chromatographic, electrophoretic, HPLC procedures), modification of proteins by acid, alkali, deamidation, glycolysation and enzyme treatments to enhance functional properties including emulsifying, foaming, and gelation properties, and investigating physicochemical properties. The research team has demonstrated enhanced protein functionalities that have resulted in a patent filing by an industry.



• *Natural Antioxidant Plant Extracts and Lipid Oxidation*

Extraction, isolation, identification of phenolic compounds from industry co-products, and plants. “Green” food-grade solvents are being used to extract phenolic compounds from a variety of herbs, spices, condiments, tea, and specialty crops. The extracts and pure phenolic compounds are being investigated to evaluate the efficacy of antioxidant properties in model systems and product application. Fenugreek extract minimized red color formation during poultry meat irradiation, and a variety of extracts including green tea and grape seed extracts minimized lipid oxidation and maintained the quality.



- **Natural Antimicrobial Plant Extracts and Food Safety**

Multiple hurdle intervention strategies using edible films and plant extracts to inhibit and prevent food-borne pathogens in meat, poultry and vegetable products. Several types of food grade edible films (proteins, hydrocolloids) with the incorporation of plant extracts containing phenolics, organic acids, peptides and their physicochemical properties and antimicrobial activities are being investigated. The physicochemical activities include color, flavor, texture, sensory, water vapor and gas permeability, and the pathogens include *Listeria monocytogenes*, *E.coli* 0157:H7, and *Salmonella*. Organic acids incorporated edible antimicrobial films has been patented. Research is in progress using nanotechnology to further enhance pathogen inhibition in food products. The mode of action of the natural antimicrobials is currently under investigation.



- **Enzymatic Protein Hydrolysates as Health-promoting Agents and Proteomics.**

Hydrolyzing protein/co-products with food grade proteolytic enzymes, separating the soluble peptide fractions, subjecting to ultrafiltration, investigating for gastrointestinal resistance and anti-cancer activity in human cell lines is in progress. The peptides will also be investigated for antioxidant, antimicrobial, antihypertensive, antidiabetic, antimutagenic, antihypercholesterolemic, and anti-alzheimer's properties. The peptides that demonstrate bio-activities will be separated, characterized, sequenced, and synthesized if needed.



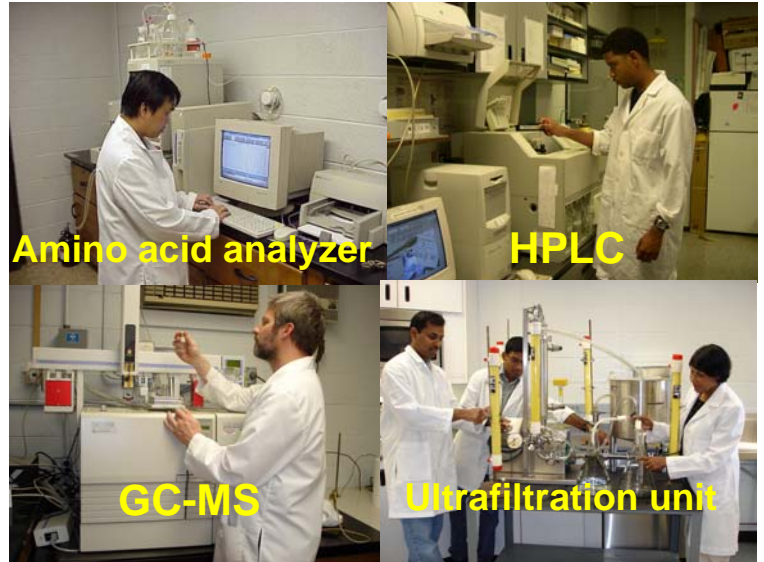
- **Value Added Nutraceutical/Phytochemicals/Functional Food/Designer Food/Ingredients from specialty crops and Industry co/by-products.**

The specialty crops include vegetable soy bean and bitter melon (gourd). Isoflavones, polyphenols, alkaloids are being extracted, separated and characterized. The bitter compounds in bitter melon have been isolated and identified. Pre-biotics for probiotics through fermentation technology from an industrial co-product is in progress. Extrusion technology is being used to produce value-added edible films, and also to enhance the functional properties of co- and by- products from industry.



The protein chemistry lab is well equipped with the state of these equipments including:

- HPLC
- GC-MS
- Amino acid analyzer
- Ultrafiltration unit
- Centrifuge
- Automated Kjeldahl
- Extruder
- Texture analyzer
- Viscometer
- Oxidative Stability Instrument
- Spectrophotometer
- Spectrofluorometer
- UV light device
- Sonicator, homogenizer, extractor
- Freeze-drier
- Spray-drier
- Bioreactor with all accessories
- All facilities for food safety research in Biomass Building



The protein chemistry lab also has access to the following facilities in the department/university:

- Food safety research in Biomass Building
- Biofilm
- Anticancer research
- Peptide sequencing
- Analytical ultracentrifuge
- Animal feeding studies
- Nuclear Magnetic Resonance (NMR)
- Transmission electron microscope (TEM)
- Scanning Electron Microscope (SEM)

List of Patents and Selected Recent Publications:

1. **Hettiarachchy, N.S.**, Eswaranandam, S. 2007. Organic acids incorporated edible antimicrobial films. US Patent. Patent No.: US 7,160,580 B2. Date of patent: Jan. 9, 2007
2. **Hettiarachchy, N.S.** 2006. Value-added novel uses of rice bran extract. Patent filed by the university, March 2006.

3. **Hettiarachchy, N.S**, Paraman, I, Shaefer, C. and Beck. 2005. Protective hydrocolloid for active ingredients. DSM in (formerly Hofmann La Roche) Switzerland, patent filed by the company, January 2006.
4. Ilankovan P., **Hettiarachchy, N.S.**, Schaefer C., and Beck M. I. 2006. Physicochemical properties of rice endosperm proteins extracted by chemical and enzymatic methods, *Cereal Chem.* 83(6):663-667
5. Theivendran S, **Hettiarachchy N.S**, and Johnson MG. 2006. Inhibition of *Listeria monocytogenes* by nisin combined with grape seed extract or green tea extract in soy protein film coated on turkey frankfurters. *J Food Sci* 71(2):M39-44.
6. Bo Zhang, B., **Hettiarachchy, N.S.**, Chen, P., Horax, R., Cornelious, B., and Zhu, D. 2006 Influence of the Application of Three Different Elicitors on Soybean Plants on the Concentrations of Several Isoflavones in Soybean Seeds. *J. Agric. Food Chem.* 54(15):5548 - 5554
7. Rababah, T., **Hettiarachchy, N.S.**, Horax, R. Cho, M.J. Davis, B. and Dickson. J. 2006. Thiobarbituric acid reactive substances and volatile compounds in chicken breast meat infused with plant extracts and subjected to electron beam irradiation. *Poult Sci* 85:1107-1113
8. Horax, R., **Hettiarachchy, N.S.**, and Islam, S. 2005. Total phenolic contents and phenolic acid constituents in 4 varieties of bitter melons (*Momordica charantia*) and antioxidant activities of their extracts. *J Food Sci.* 70:C275-C280.
9. Eswaranandam S, **Hettiarachchy N.S**, and Meullenet JF. 2006. Effect of malic and lactic acid incorporated soy protein coatings on the sensory attributes of whole apple and fresh-cut cantaloupe. *J Food Sci* 71(3):S307-313.