RESEARCH LINE: PHYSICAL SEPARATION

PHASE EQUILIBRIUM AND APPLICATION IN THE SEPARATION PROCESS.

Professor Antonio Jose de Almeida Meirelles

Participant professors: Eduardo Augusto Caldas Batista; Guilherme José Maximo; Klícia Araújo Sampaio

Laboratory of Extraction, Applied Thermodynamics, and Equilibrium-EXTRAE

Description: Determination, modeling, and prediction of vapor-liquid, liquid-liquid, and solid-liquid equilibrium. Determination, modeling, and prediction of water activity of solutions. Liquid-liquid equilibrium of vegetable oil systems (fatty acids - short-chain alcohols), and aqueous two-phase systems. Modeling the liquid-vapor equilibrium using Gibbs excess free energy equations. Solid-liquid equilibrium of natural products. Characterization and modeling for prediction of physical properties of multicomponent systems in the food, pharmaceutical, materials, and bioenergy industries. Characterization and prediction of phase equilibrium, with an emphasis on solid-phase characterization. Extraction and crystallization processes (experimental assays and simulation) in foods, biopharmaceuticals, and biomaterials. Characterization of phase equilibrium and simulation of gastrointestinal processes involving food and biopharmaceuticals. Formulation of foods, biopharmaceuticals, and biomaterials based on their physical properties and thermodynamic equilibrium.

PHASE EQUILIBRIUM FOR SUPERCRITICAL FLUID EXTRACTION

Professor Fernando Antonio Cabral

Laboratory of Extraction, Applied Thermodynamics, and Equilibrium- EXTRAE

Description: Use of supercritical extraction in oil and fat processing. Production of special extracts from complex lipid mixtures and their by-products. Fractionation and phase equilibrium. Supercritical extraction to obtain extracts containing compounds with active properties with an important role for food or pharmaceuticals. Microencapsulation of active compounds and antisolvent properties of supercritical carbon dioxide.

PROCESSING FOOD AND BY-PRODUCTS AT HIGH PRESSURES.

Professor Julian Martinez

Laboratory of High Pressure in Food Engineering– LAPEA

Description: Processing of natural products using fluids at high pressures, mainly carbon dioxide (CO_2), ethanol, and water. The use of pressurized solvents is an alternative to both toxic organic solvents and techniques that require high temperatures. The apparatus is intended for the extraction, fractionation, and formation of nanoparticles of bioactive compounds from raw materials or residues from the food industry, and the synthesis of esters through reactions with

the possible use of enzymes. In the extraction step, supercritical carbon dioxide and pressurized water are used as solvents. Additionally, ultrasound technology is used to speed up the extractions processes and increase yields. The extracts obtained with and without the use of ultrasound are subjected to encapsulation process through techniques using supercritical CO_2 as an antisolvent (SAS and SFEE). The microparticles are characterized for particle size, uniformity, morphology, concentration, and stability of the bioactive compounds. The controlled release kinetics of the compounds and stability in the medium are evaluated. Finally, the biological activities of the extracts and encapsulated products are evaluated through specific assays. Extract purification can be performed by low-pressure fractionation, membrane filtration, and high-pressure adsorption. Ester synthesis is performed using supercritical carbon dioxide as the reaction medium, alcohols, sugars, fatty acids, and terpenes as substrates, while immobilized lipases are used as a catalyst, generating terpenic or sugar esters as products.

HIGH TURBULENCE EXTRACTION ASSISTED BY ULTRASOUND AND SUPERCRITICAL FRACTIONATION FOR PROCESSING AND STABILIZATION OF PLANT EXTRACTS AIMING TO OBTAIN FUNCTIONAL FOODS

Professor Maria Angela de Almeida Meireles

Participant Professor Dr. Luiz Henrique Fasolin

Laboratory of Supercritical Technology: Extraction Fractionation, and Identification of Plant Extracts– LASEFI

Description: Production, fractionation, enrichment, and stabilization of extracts from aromatic, culinary, medicinal plants, and by-products such as fruit processing residues, seeds, rhizomes, etc. Clean technologies are used to preserve the environment without harm to human and animal health, at all processing stages, through the use of innovative technologies, such as extraction and fractionation with supercritical fluids, stabilization by micronization and encapsulation, formation of micro, mini, and nanoemulsions, among others. The subprojects are conducted in the following themes: (1) Determination of process parameters: supercritical and conventional extraction; (2) Determination of thermophysical properties of plant extracts; (3) Determination of phase equilibrium of plant extracts in supercritical fluids; (4) Economic engineering applied to the processing of bioactive products; (5) Study of the functional properties of plant extracts; (6) Extraction with pressurized fluids: CO_2, water, and others; (7) Fractionation, standardization, and purification of plant extracts; (8) Conventional methods for the production of plant extracts: steam drag extraction and solid-liquid extraction; (9) Stabilization methods of bioactive compounds from plant extracts through micronization/encapsulation using supercritical fluids; ultrasonication and conventional techniques; (10) Reactions in supercritical medium: hydrolysis, polymerization, and others; (11) Supercritical fluid chromatography; (12) Sustainable process integration/intensification of processes.