Food Science Graduate Student Seminars

Confirmation of Candidature Seminars

Friday February 5th 1:00-3:40 pm

Room 3.1.09

Come and hear about these latest directions in Food Hydrocolloids Research

All Welcome

Light lunch will be provided from 12:00 noon

Utilisation of the Concept of Glass Transition Temperature (T_g) to Control the Kinetics of Enzymatic Activity in Carbohydrate Matrices

Understanding the molecular dynamics of carbohydrates at the vicinity of T_g leads to the desire to improve the stability and quality of processed foods at which chemical reaction pathways and enzymatic processes are critical considerations. In this context, enzymatic activity relates to the diffusion-controlled substrate/enzyme interaction whereas chemical studies are mainly interested in the prevention of flavour and colour degradation or fat rancidity. Attempts were made in the literature to follow the rates of reactant consumption with the predictions of the reaction rate or free volume theories. However, in several reports neither theory was able to follow convincingly the kinetics of molecular processes in the glass transition region. Problems encountered include negative estimates or physically unrealistic high values of free volume, etc. This project aims to develop carbohydrate matrices based on distinct patterns of glycosidic linkages and conformation leading to well defined structural properties. These will be identified with mechanical spectroscopy, differential scanning calorimetry and light/electron microscopy. Incorporation of enzymatic preparations will be monitored using directly the glassy matrix as the substrate (e.g., system of starch/α-amylase) or by incorporating the reactive system within a non-metabolisable glassy matrix (e.g., PNPG/α-glucosidase in deacylated gellan/polydextrose). Quantification of the kinetics of matrix vitrification and enzymatic activity in relation to T_g will be pursued thus providing a fundamental pathway of controlling such phenomena in food related model systems.

Presented by ***Vinita Chaudhary***

Application of the Materials Science Approach to the Structural Properties of Whey-Protein Based Composite Gels from Low to High-Solid Systems

Despite the increasing appreciation that whey is a valuable resource of the dairy industry, as opposed to a waste product of the cheese and casein industries, there have been drawbacks in its utilisation as a functional ingredient in processed food products. In Australia, only 25% of whey production finds its way in domestic manufacture, with the remainder being “off-loaded” abroad as a cost-effectively managed waste stream of cheese processing. However, there is an immense potential for whey and its derivatives to be included at high levels in manufactured foods. Potential benefits include improvement in nutritional quality, imparting flavour and colour due to the presence of lactose that takes part in Maillard reactions with the protein, as fat replacer in low-fat dairy products when it is co-gelled with polysaccharide, and as an ingredient in starch based formulations (e.g., breakfast cereals, snacks and energy bars). Therefore, the aim of the first part of this project is to apply the techniques and concepts of the materials science approach for the determination of the composition of individual phases in biphasic gels of whey protein in the presence of starch. This will be accomplished via theoretical modeling that determines the phase continuity, phase inversion and solvent distribution between the two phases. Besides the area of low and intermediate-level of solids mentioned in the first objective, the project will deal with the rapidly growing sector of high-solid materials. It will prepare mixed whey protein/starch systems at high levels of solids in order to examine the structural morphology of networks and the phase topology of the material. Manipulation of glassy phenomena *via* DSC and the newly introduced concept of network (mechanical) glass transition temperature (T_g) will assist in determining the kinetics of structural transformation in single or bimodal patterns of vitrification.

Presented by ***Lita Katopo***

Effect of Added Counterions on the Glass Transition Properties of High-Solid Starch Based Systems with Variable Moisture Content and Relative Humidity

Snacks are a rapidly growing sector of the food industry. In the USA, for example, the Centres for Disease Control and Prevention recently reported that 21% of Americans obtain their daily calorie intake from snack foods and beverages. Along with starch, increasing use of other ingredients particularly salt to achieve a variety of textures and sensory properties can have a profound effect on the physicochemical characteristics of the final products. However, molecular studies on the incorporation of salt in snacks are scant in the literature, although the subject has important technological implications and affects the nutritional quality of products. This project aims to assess the variation in glass transition temperatures of extruded starch in the presence of salt *via* the competing mechanisms of increased molecular mobility, increased moisture retention or the action of salt as a catalyst for caramelization, which is due to the hydrolysis of starch to glucose by a large number of ions during high-temperature extrusion. It will further document the effect of salt on the structural properties of samples incorporating the following soluble dietary fibre components: low methoxy pectin, high guluronate alginate, agarose, guar gum and xanthan gum. These have been selected based on fundamental considerations spanning the range of conformational type: disordered (guar gum), isolated order (xanthan gum) and aggregated order: (alginate and agarose); charge density ranging from neutral (agarose) to one charge (deacylated gellan) and two charges (pectin) per repeat sequence; and capacity for network formation ranging from non-gelling guar gum to gelation at concentrations down to about 0.1% for agarose. Analysis will be facilitated by a suitable framework of thought from the “sophisticated synthetic polymer approach” adapted for the particular requirements of contemporary research and innovation in biomaterials science.

*Presented by **Lillian Chuang***

Fundamental Studies of Dietary Fibre and Sugar Analogue Interactions in High-Solid Preparations

High-solid biomaterials increasingly include a number of non-starchy polysaccharides, i.e., dietary fibre to deliver a range of properties such as structure, storage stability, processability, etc. Gelatin, which for almost a century has been produced on an industrial scale, is the often used structuring agent in high-solid foods and pharmaceuticals, but is increasingly falling ‘out-of-fashion’ with consumers and producers alike. Furthermore, it was the rapid introduction in the 1970s of high-fructose corn syrup into the food supply that has been recognized as an important factor contributing to the obesity epidemic that has swept the world in the last 30 years. This project aims to develop methodologies and characterize the structure-function relationships in high-solid biopolymer systems. It will examine how varied conformational characteristics in a high solids environment can develop rubbery networks. The effect of network formation on structural properties of these systems will be probed using the concept of thermorheological complexity also known as the coupling theory. It will further develop a database of physicochemical measurements in high-solid materials by utilising polydextrose as a sugar replacement in formulations. Systems of interest are gelatin, agarose, κ-carrageenan, and deacylated gellan in the presence of polydextrose as co-solute spanning the range from low to high-solid systems. Thermomechanical properties, in terms of the coil-to-helix transitions of macromolecules, rubber-to-glass transformations and large deformation properties of high solid samples are of particular interest in this exercise in order to provide fundamental understanding of structural behaviour. Acquiring comprehensive knowledge of functional properties in basic preparations and systems containing sugar analogues should allow development on a sound technological basis of products that satisfy special dietary needs.

*Presented by **Omar Al-Mrhag***