Introduction

We are concerned with predicting and explaining how food behaves in processing and storage. Classically food scientists are concerned with bulk properties (how big) or chemical properties (molecules formed and lost). The link between those two scales is very poorly understood in chemical terms and in fact do not depend on changes in molecular structure but instead the arrangement of molecules and groups of molecules one to another. This type of thinking provides the link between the fine structure and bulk properties.

In principle we should be able to consider the molecules in a food, calculate their interactions, and calculate how the bulk will behave. Unfortunately reality is far too complex and instead we accept larger structural units as our building blocks, e.g., sugar crystals, oil droplets, starch granules, xanthan polymers, and consider how they interact and come together. The key is often working out which structural scale is responsible for the bulk properties of the food. For example consider milk –why is it opaque but skim milk is bluish?

In this section we will broadly try to work up through the scales of structure and understand the physics relevant to each. The focus will be on understanding the key principles in model systems and then seeking to apply them to food systems. A model system simplified food that carries some but not all essential features of a complete product in such a way that it is easy to isolate the core principles. Consider the milk example – if we wanted to look at the opacity of orange juice we might look at a suspension of polystyrene sphere in water to understand the physics of electromagnetic wave-suspension interaction then try to move onto trying to see how the conclusions apply in a real system.

What other approaches could you take to reach a useful solution?

In general, the better the understanding of the whys of a process, the better and more general the conclusions available. The advantage of the more general conclusion is it allows you to make predictions about the behavior of completely unknown systems. The difficulty is in knowing which physical principles most relevant and making sure the model system models the important aspects.

Paper for Discussion: "Molecular origins of structure and functionality in foods" Tom Eads

1. What is functionality?
2. What does Eads mean by a hierarchy of structure?
3. What is the difference between internal and external forces?
4. Consider a food product or process you are particularly interested in. How does Eads hierarchy apply?
5. What model systems are used in your particular field of study? What properties are modeled and which are neglected?