

RALEIGH, NORTH CAROLINA, USA
MAY 30TH - JUNE 2ND, 2000

A shortcourse entitled *Rheological Analysis of Foods: Theory and Practice* was conducted by the North Carolina State University Department of Food Science in Raleigh, North Carolina during May 30 – June 2, 2000. This was the sixth food rheology shortcourse hosted by North Carolina State University and was sponsored in part by the Southeast Dairy Foods Research Center. General lectures, hands-on laboratory exercises, as well as group discussions of practical applications and case studies were used to convey the fundamental concepts of food rheology.

The shortcourse instruction was provided by a group of university and industry food rheology experts. C. R. Daubert, E. A. Foegeding, and T. C. Lanier of North Carolina State University and M. A. Drake of Mississippi State University were joined by E. K. Chamberlain of Kraft Foods, Inc. to provide lectures, instruct laboratory exercises, and lead group discussions.

The course was directed towards basic research and product development scientists in industry, academia, and government concerned with the rheological and textural analysis of foods. Seventeen representatives of industry and academia, along with several graduate students from North Carolina State University, participated in the shortcourse. Representatives of food processors, hydrocolloid companies, ingredient suppliers, and research institutions attended the short course to learn how rheological properties relate to food quality, stability, process design, and formulation.

The shortcourse attendees arrived in Raleigh on Tuesday evening. In conjunction with registration, a welcome and social period was held. The participants received their course materials and

had a chance to meet the instructors and fellow participants. The course began Wednesday morning with an introduction and discussion of the course objectives by C. R. Daubert and E. A. Foegeding. The first lecture, by E. A. Foegeding, provided an overview of the analysis of foods from the perspectives of biological, polymer, and material sciences. T. C. Lanier then presented a lecture explaining fundamental and empirical rheological properties of foods. Following the first two lectures, a group discussion answered questions and discussed practical situations with the participants. From this discussion, the participants realized that although empirical measurements have a place in industry, the mechanisms governing flow behavior are better understood via fundamental rheological techniques. C. R. Daubert gave the last lecture of the morning, presenting the principles of steady shear methods for fluids and a description of various fluid behaviors encountered in food rheology.

The afternoon session began with a fluid rheology laboratory, where the participants learned to determine Newtonian viscosity of corn oil, apparent viscosity of salad dressing, yield stress of ketchup, and temperature-dependent viscosity of honey. The laboratory also demonstrated the advantages and disadvantages of different viscometers, rheometers, and rheological attachments. Following the laboratory, E. K. Chamberlain gave a lecture on the practical applications of fluid rheograms and described particular industry cases where rheological solutions have been used. For example, a case study was discussed that revealed the importance of temperature control in rheological measurements. In the last lecture of the after-

Figure 1 (left):
C.R. Daubert discusses
geometries used in steady
shear fluid rheology.



Figure 2:
E.A. Foegeding and P.J. Luck
explain calculations used for
ketchup yield stress
determination.



noon, C. R. Daubert presented the principles of large strain rheology of solids, including a detailed analysis of torsion testing. After a recap of the first day's topics, the participants had dinner at Raleigh's famous Angus Barn.

The second day started with laboratory exercises about compression and torsion fracture. The participants were introduced to compression testing of hotdogs, torsion testing of hotdogs and cheese, and failure characterization of cheese using the vane method. The concept of a texture map was introduced to relate the importance of stress and strain of materials at fracture. After the laboratory discussion, the morning continued with two lectures. T. C. Lanier provided a talk on how fundamental fracture data can be used to optimize product development and ingredient formulation. C. R. Daubert then explained the concept of viscoelasticity and the basics of small amplitude oscillatory rheology.

Thursday afternoon started with a lecture on small strain testing of viscoelastic food materials. The focus was on the fundamentals of dynamic shear, step strain, creep and recovery experiments, and results interpretation. A viscoelasticity laboratory was then offered to demonstrate the principles from the lecture. The participants examined low and full fat cheeses using a stress controlled rheometer to perform creep recovery tests and used a strain controlled rheometer to conduct a relaxation experiment. In addition, the participants learned to examine the mechanical spectra of foods. E. A. Foegeding discussed the application of small strain experiments and how these tests may be used to study and quantify the structure and behavior of food systems. Particular attention was given to the

subject of gel point determination. E. A. Foegeding discussed with the participants the difficulty in finding the gel point for protein gel systems, and techniques used for gel point determination. The last lecture of the afternoon was given by M. A. Drake. Dr. Drake described the aspects of sensory analysis and how it can be used to evaluate the textural attributes of foods. The evening concluded with dinner and a comedy performance at Charlie Goodnight's Comedy Club.

The final day of the shortcourse started with a sensory analysis laboratory in which M. A. Drake explained the aspects of three types of sensory analysis scales. The class then applied these scales to evaluate rate and smoothness of melt for chocolate chips, bite-pull and toothstick of licorice, as well as firmness and cohesiveness of cheeses. E. A. Foegeding offered the final lecture of the course, speaking about correlations between sensory and rheological data. C. R. Daubert provided a review of the course and presented the participants with a NCSU rheology shortcourse t-shirt and a certificate of completion.

The rheology shortcourse will be offered again in May 2001. For more information visit www4.ncsu.edu/unity/users/c/cdaubert/www/short_course/ or contact C.R. Daubert at chris_daubert@ncsu.edu.

J. J. Resch and C. R. Daubert
North Carolina State University
Department of Food Science
Raleigh, NC 27695/7624
USA
x1.919.513.2092
chris_daubert@ncsu.edu



Figure 3 (left):
M.A. Drake prepares the participants to evaluate the sensory texture of chocolate chips.

Figure 4:
Shortcourse participants and instructors gather for a group photograph.