ESS science symposium: Neutrons and Food 2012

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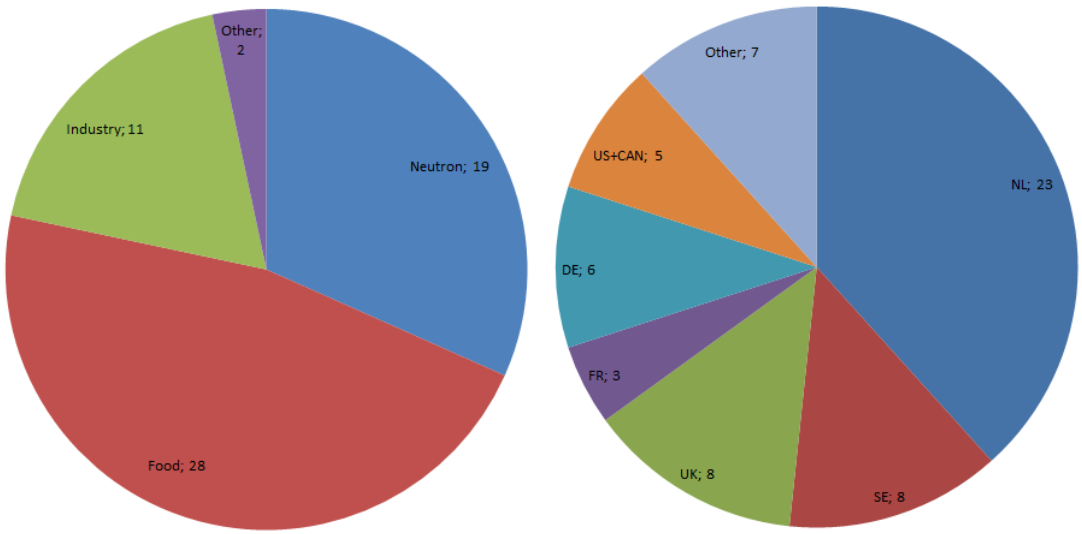
How can neutron scattering help to make wine tastier, to extend the shelf life of food by improved packaging, improve the recipe for fresh cheeses, fight obesity or make the crust of bread ever crustier? Those were some of the questions discussed by sixty international scientists convening in Delft from 29 January to 1 February 2012. The combination of neutron experts and food scientists resulted in very engaging and fruitful discussions.



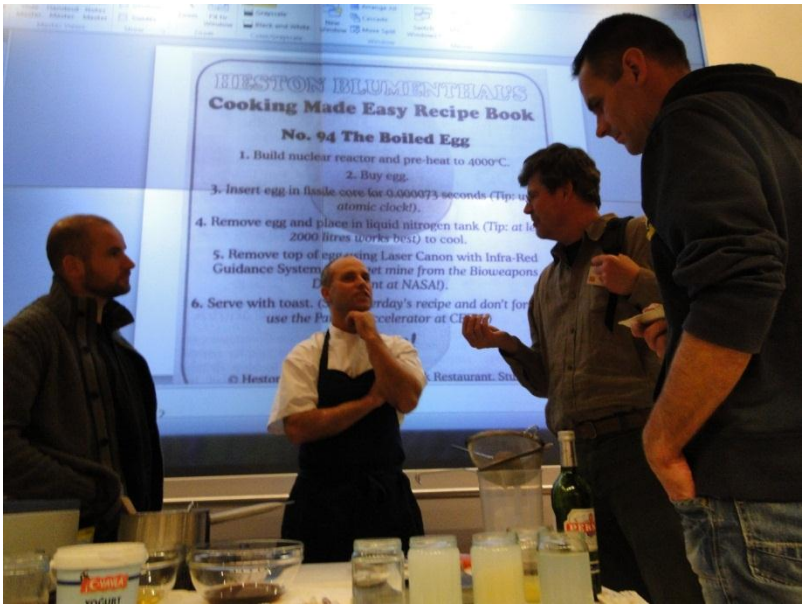
The first pie chart shows the scientific background of the participants. There was a good balance in participants from neutrons facilities, food institutes and from industry. This balance was essential for the discussions. The second pie chart shows the country in which the participants are based. Nearly all participants from industry came from the Netherlands.

The neutron people presented examples using neutron scattering on food materials: Andrew Jackson from the ESS gave a very clear introduction into the most relevant neutron techniques for food science. The food scientists presented the progress in their fields of science and asked how neutron scattering can help to solve their questions concerning structure or dynamics of food materials. Martin Leser from Nestle gave an overview of which processes in food science are important in the chain from raw ingredients to the final packaged product in the supermarket. In nearly every step the changes in structure are relevant for the quality of the final product.

The workshop programme covered neutron techniques and food topics. The food themes included water dynamics, digestion, food packaging, protein conformation, casein micelle aggregation, foams, interface phenomena, hydrogen bonds, organogels, food safety and food preservation by freezing or increased pressures. For the neutron methods, we had presentations on SANS, reflectometry, SESANS, inelastic scattering and tomography.

Some aspects of the systems that might be studied with neutrons are: morphology of separate structures, such as fibrils, platelets and finer topological details, resulting from molecular assembly. On a larger hierarchical level, morphological aspects in mixtures and according phases and phase behaviour are of interest. On the smaller scale of molecules, water effects, such as hydrogen bonds,

protein structure, and dynamics of exchange and small scale syneresis effects are important. The ability to study multi component systems is of particular importance to the foods community, in view of the typical composition and type of challenges the food area faces. Regarding food systems, one important system is dairy, and encompasses different scales: caseins, calcium balance in milk, interactions surfactants, water dynamics, fusion of micelles in cheeses and protein-polysaccharides. Interaction between the food and its environment is for example important in the area of packaging materials.The social programme started with a welcome reception in the Vermeer Centre in Delft. Appropriately, this illustrated our symbol for the workshop, i.e. the milk maid of Vermeer. The guides gave a detailed explanation of this painting, including all the hidden erotic symbols shown. Eke Mariën and Jan Groenewold, better known as Cook and Chemist, ended the first day with a lecture titled: Scattering in the kitchen. They performed a beautiful and tasty experiment: infusing strawberries with green tea in a vacuum container. This process replaces the air in the strawberry by green tea, which has a good contrast match to the strawberry. The result is a translucent strawberry with a great taste. Food tasting continued during the conference dinner in the Prinsenkelder, a very historic place in Delft.



Eke Mariën (Cook) discusses with Lambert van Eijck (left), Ad van Well and Jeroen Plomp (right) how to boil a perfect egg.

Conclusions from the workshop are: Structure (interface and bulk) reflects the information relevant to a food system from the nanometre to millimetre scale. Most relevant is the evolution of the structure as a function of temperature, external stresses (flow, high pressure) and ingredient concentrations (including digestive circumstances).

The workshop ended with a discussion about how the ESS (or any other neutron facility) can encourage experiments related to food science and consequently advance the field. On the wish list are: deuterated compounds, chemistry labs next to the hutch, sample environments with shear, temperature, microwaves and other conventional food processing conditions, flexible access at short notice for trial experiments (for example as the SANS-express at ISIS), support with data-analysis, simultaneous experiments using other characterisation techniques and time-resolved measurements.

Do we need a next neutrons and food? In 2010, ANSTO organised the first Neutrons and Foods in Sydney, a successful workshop that attracted some 60 participants, however, only 6 people attended both meetings. In both workshops the neutron scatterers came from far away, whereas the food scientists were rather local; nearly all industrial participants came from the Netherlands. However, the workshop is a good outreach tool as many food scientists are apparently interested in neutron scattering, but they know little about it. Following newly established contacts at this workshop we anticipate novel experiments in this area. We think it will be good to organise another Neutrons and Food in a few years moving to another country with strong food science and industry. In Europe, France and Switzerland would be obvious locations.

The workshop Neutrons and Food 2012 was organised by the Delft University of Technology and chaired by Wim Bouwman, Reactor Institute Delft, and Erik van der Linden, Physics and Physical Chemistry of Foods, of the Wageningen University, the Netherlands. It was one of the series of ESS Science Symposia and we would like to acknowledge the ESS for generous sponsoring, their help and advice. Thanks also to all the participants: their active participation made the workshop a real success.

Participants of the workshop. Photographer Menno Blaauw from the Reactor Institute Delft.