REPORT ON NEUTRONS AND FOOD WORKSHOP

Hosted by

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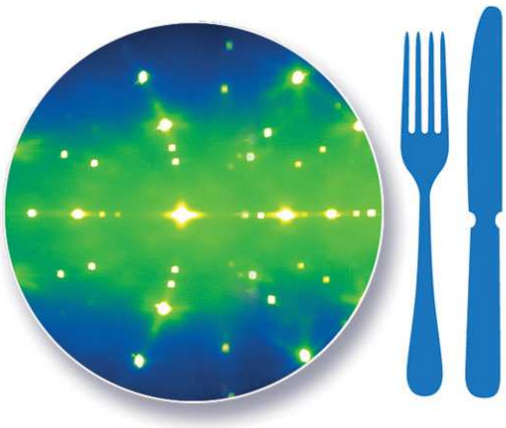

Neutrons and Food

Sydney, Australia

31 October – 3 November 2010

Herma Buttner and Elliot Gilbert

Australian Nuclear Science and Technology Organisation


Australian Government
ansto


Australian Government
Department of Innovation, Industry, Science and Research


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Good Food, Good Life

Executive summary

Over 50 participants gathered at the Neutrons and Food workshop in Sydney, with greater than 60% coming from abroad: 18 from Europe, 10 from North America, 4 from New Zealand and 3 from Asia complementing 21 participants from Australia. Apart from presentations (10 invited talks, 13 short talks and 10 posters), the workshop provided a speed networking opportunity, a dinner cruise on Sydney harbour and a visit to ANSTO's neutron scattering facilities at the conclusion of the meeting.

There was ample opportunity for discussion; this resulted in a focus in four main areas:

- model systems;
- interaction between facility, academia and industry;
- collaboration and outreach;
- access to large-scale facilities;

Recommendations

1. Model systems are important in understanding the behaviour and processes around food, including structural and dynamical measurements using various techniques (neutron, NMR, synchrotron, etc) combined with molecular-dynamics simulations. As real food-systems are generally highly complex, initial studies should focus on simple systems and working hypotheses could be tested. Subsequently, this will provide a better hypothesis for understanding real food processes.
2. It is vital there is a dialogue between the researchers that design the model and those that will subsequently utilise the model to ensure that the model is viable and relevant to the question being investigated.
3. There are evidently links between industry and academia and large-scale facilities; however, the current links are rather linear. Industry often outsources research to academia. Academia then attempts to solve problems relevant to the food industry. Large-scale facilities require academia because scientists at large-scale facilities are not experts in the field of food science; equally well, food science academics are not experts in neutron scattering. Neutron scattering, in turn, is one step removed from industry. New collaborative approaches are needed.
4. Collaborations should embrace all areas - it should be multidisciplinary - and include the sharing of knowledge and resources. It may be utilised to build equipment, e.g. specialised sample environment or to share samples (e.g. the deuterated chemicals required for a neutron-scattering experiment may also be appropriate for NMR research). The establishment of networks is therefore recommended.
5. Further meetings are desirable. Key conference should be identified in food materials science into which either symposia could be included or satellites be associated.
6. Workshops that combine different techniques would be useful. In the long term, the industry regulatory bodies should also become involved.
7. Neutron scattering peer-reviewed proposal access systems should be reviewed. Consideration should be given to: the development of short

calls for the food industry; possibility to test samples or feasibility studies; faster turnaround time, inclusion of food-science community in peer review.

8. Neutron facilities need to drive their own science and build partnerships, i.e. have scientific and programmatic proposals.
9. Good outreach is important to promote “visible” experiments, also in view of government being stakeholder, especially in the area of health and nutrition.
10. Neutron-scattering facilities may not be communicating their capabilities well enough in the areas of public health and industry. Facilities could provide fact sheets (basic technological facts) for the food industry, listing methods and example studies that can be utilised to solve problems in food science.

The Neutrons and Food workshop was truly an international meeting with attendees coming from both academia and industry.

Objectives of workshop
The “Neutrons and Food” workshop was held to identify the future scientific needs in the application of neutron scattering to Food Science. The application of neutron scattering to food-based systems is still in its infancy but has significant potential to understand the complex relationship between food structure, processing, rheology, nutrition, food quality and security.

Scope, Participants and Keynote Speakers
The workshop featured lectures (10 invited and 13 contributed) followed by animated discussions, a speed networking (between food and neutron specialists) and poster session comprising 13 posters. The abstract booklet with programme can be downloaded at http://www.nbi.ansto.gov.au/neutronsandfood/program.html.

The following topics were discussed:
- Protein and complexes
- Digestion and metabolic processes
- Drinks and beverages
- Dairy
- Lipids and fats
- Glassy states
- Food packaging and food safety
- Plant materials

The following keynote lectures were given:
- Rex Hjelm, LANSCE, USA - "Bile Physiology and Physical Chemistry in Digestion: Fundamental Insights from Small–angle Neutron Scattering"
- Carl Holt, University of Glasgow, UK - "Quantitative models of casein micelle structure derived from SAXS and SANS"
- John Katsaras, NRC, Chalk River, Canada - "Neutron Scattering, Hydrogenous Materials and Nutraceuticals"
- Susan Krueger, NIST, USA - "Protein structure and interactions in the solid state"
- Ross Lee, PTIS, USA - "Need for neutron scattering techniques in packaging"
- Peter Lillford, University of York, UK - "Neutrons and Food: What are the problems?"
- Camille Loupiac, Université de Bourgogne, France - "Protein structure (SANS), water and protein dynamics (Elastic and Inelastic Neutron Scattering), and protein–lipids interface (Neutron Reflectivity). How neutron scattering experiments can target the behaviour of model food proteins?"
- Hans Tromp, Nizo, The Netherlands - "Neutron scattering study of food structure: gelation, coacervation and the effect of high pressure"
- Aude Vernhet, INRA, France - "Colloidal interactions involving condensed tannins in diluted systems: what problems can we solve through SANS?"
- Elliot Gilbert, ANSTO, Australia “Neutron Scattering – A Natural Tool for Food Science and Technology Research”.

Participants came from academia, industry and from the fields of both food science and neutron scattering, with over 60% coming from abroad: 18 from Europe (France, Hungary, Latvia, Netherlands, Sweden, Switzerland, UK), 10

from North America (USA, Canada), 4 from New Zealand and 3 from Asia complementing 21 participants from Australia (see appendix for list of participating institutions). The speed networking session on the first day greatly enhanced interaction and discussions. The social networking continued at the workshop dinner with a cruise on Sydney harbour. A visit to ANSTO's neutron facilities was offered at the end of the workshop.

Speed networking – Food materials scientists on the left and neutron scatterers on the right.

The feedback from the workshop was extremely positive (32 replies). Two comments summarise the overall feedback:

"Very good workshop, overall. Good coverage of topic related to the application of neutron scattering with many good/high standard research and excellent speakers. This workshop should serve as a first effort "seed" to connect researchers who have an interest in this area. Thank you for organising this wonderful workshop."

"I would like to thank you both for making the workshop one of the most pleasant professional experiences that I have had in recent times. The amount of work that you and your colleagues invested in the workshop was evident to all. I also very much enjoyed our discussions, and I am looking forward to future interactions with you. Thank you for making me feel most welcomed in your country."

Summary of discussions

The discussions focussed around four main areas:

- model systems;
- interaction between facility, academia and industry;
- collaboration and outreach;
- access to large-scale facilities.

It was agreed that the most pressing questions are always related to very complex systems; on the one hand, the structure and dynamics of food are studied on multiple length and timescale, but there is also a need to understand other essential aspects e.g. physiological and metabolic aspects. The best way forward in understanding the behaviour and processes around food are model systems. Furthermore, given the range of disciplines required to enable a system to be properly untangled, the workshop identified that there is a need of increasing interactions between various communities. Currently, there are few opportunities or meetings in which this can be achieved; the attendees noted that this workshop provided such a mechanism. Possibilities were raised as to how to set up networks and collaborate including outreach activities. Finally, access to large-scale facilities was discussed including possible changes to the system with a view to better attracting and integrating the food community.

Model systems

- Complicated systems can be broken down in smaller portions. Properties need to be translated into models; this can be for structural aspects as well as for dynamics.
- Suggestion for modelling systems: create models, consider and screen them with researchers from complementary disciplines e.g. biologists.
- It is important to specify the conditions that are required for the models, e.g. temperature, varying pH, and other aspects that may mimic food.
- The ability to mimic food processing conditions is important (suggested temperature range ca. -18C to 160C)
- The variety of material is relevant, e.g. different starches exhibit different behaviour.
- A combination of structural and dynamics measurements is beneficial. However, a dynamics study might take longer and is thus higher in cost. It may be necessary to deuterate a specific group and combine NMR and neutron techniques (molecules that are too large for study with NMR are suitable for neutron scattering).
- Including molecular dynamics could lead to many new directions in investigating models and systems. For example, protein mobility can be studied using selective deuteration; neutron dynamics can validate the molecular dynamics. Is it possible to evaluate whether proteins regain their native structure upon thawing or reconstitution? This model aspect in a physical environment could identify how protein molecules interact with organisms, e.g. not only gain an understanding of texture and taste but also measuring rates of digestion and release.
- Replacement of H_2O with D_2O cannot be assumed to have no influence on the biochemistry e.g. cannot form yoghurt from deuterated milk, changes in hydrogen bonding etc.
- It is vital there is a dialogue between the researchers that design the model and those that subsequently utilise the model to ensure that the model is

viable and relevant to the question being investigated. Often there is a lack of dialogue.

- Pharmaceutical industry could be used as an example: The problem requires simplification to enable information to be discerned but the problem needs to be relevant to develop a valuable hypothesis and kept in context.
- There are still many questions on micelles that require real data to distinguish between models, e.g. stability of the structure of the micelle itself, the role of co-solvents. The casein micelle is as important to the dairy industry as steel is to the steel industry, yet there is still a debate as to its structure, how it is formed and how it behaves.
- Understanding the oil/water interface is essential: e.g. drying behaviour, processing, fat and ice crystals as well as structure formation in the human body and its impact on physiology.
- Model systems need to be developed to enable an understanding of structure-function in different regions of the gastro-intestinal system. The design of model guts for neutron experiments is an engineering-driven approach, but not as useful as the development of real animal models, e.g. mouse; collaborations are required to do this.
- There is the relationship between food perception and food uptake in addition to tracking the digestion products and its effect on the organs and brain. A model for the oral mucosa and how food interacts with soft surfaces would help understand sensory perception. Such an understanding of human perception is important for industrial partners and is relevant to the role industry plays between consumers and producers.
- Retrofitting molecules into pre-developed design rules is an issue for the food industry, these scientists may not necessarily understand the behaviour nor be aware of all the techniques that can be used. A viable approach is to create a hypothesis that can be tested. As real food-systems are typically complex, simpler systems should be designed to provide a means of testing hypotheses.
- Addressing complex questions requires different disciplines to come together to understand and solve a problem. It should not be a technique-centred.

Interaction between facility – academia – industry

- There is a current lack of direct input by industry: this workshop of over 50 attendees had only 4 participants from food companies.
- Food scientists do not know which techniques are most appropriate to understand their materials. Although neutron scattering experts may not be able to do what is requested by food-industry partners, they might be able to offer something else that the food researchers have not considered. Dialogue is therefore critical.
- Model systems are generally not developed by the food industry; relevant partners are contacted that have interest in R&D. Industry generally outsources to academia, looking for intermediaries. However, large problems never go away, e.g. understanding wet-to-dry and dry-to-wet behaviour, freezing and drying.
- Scattering facilities need academia because the researchers that run scattering instruments are not experts in the field; collaborations needs to embrace all areas, not only simulating models.

- University researchers should use physical scientists as intermediaries.
- Three-way links between industry, academia and scattering facilities are required. Academia tries to deal with, and solve relevant problems from the food industry. This includes the understanding of which and how molecules are hydrolysed, how molecules are sensed through receptors; and long-term health impact.
- Biopolymers are a key class of materials of interest within de-hydration. It might be appropriate to develop a cluster group in biopolymers and food science.
- There is a need for curiosity-driven research - not just direct application research, but also basic research.
- There is some sense that the Australian food industry has little interest in science and development. However, specific groups conducting curiosity-driven research can provide a conduit. Know-how within the food industry is needed concerning processes, materials, analysis, and procedures.
- There is a time lag between technology developments. Examples from the packaging industry show that the transfer time can be long. Research that took place in universities has been used 10-15 years later in the packaging industry. Moisture penetration into packagng would be an area of interest.
- There may be industrial interest in better utilisation of supposed waste streams e.g. beverage, juice manufacture, tannins from wine manufacture.

Collaboration and outreach

- Canada has a number of Centres of Excellence of which food is represented by the Advanced Foods and Materials Network (AFMNet). Al Paulson explained that this virtual network brings people together across disciplines for discovery research and subsequent application. An example is a project to decrease salt in the diet that includes engineers, social scientists, nutritionists, scientists, industrialists, government (regulatory) and international partners. Early stage research can be taken to a stage where patents can be created and further industrial partners can be sought. At present, there is about 20-25% input by food industry. However, industry provides input before the research project starts. AFMNet has been running for 5 years. There is a quarterly reporting system on staff movements and problems encountered with go/no-go decisions every 4 months. Australia has the ‘Protein Syndicate’, namely a consortium of seven companies within the food sector interacting with researchers in CSIRO Food and Nutritional Science, the University of Queensland and the Bragg Institute at ANSTO on the investigation of proteins at low levels of moisture.
- A curiosity-driven research is needed that includes a number of disciplines in order to become aware of the potential of scattering. This includes understanding various characterisation techniques.
- Collaboration includes sharing knowledge in sample preparation and sample environment and the joining of forces to build equipment. What are the conditions that are required for experiments? For example, ANSTO is building a humidity control system. It is important to build the appropriate sample cells for measurements (cell itself is designed with ILL and BENSC, company in UK is building). The addition of pressure and temperature control and variation on humidity measurements places demands on the

design. Examples: hydration and dehydration process through controlled environment; D/H mixtures.

- Studying interactions: combine techniques, especially structure and dynamics; very fast processes may sometimes be difficult to follow with neutrons. While time resolution at a synchrotron is greater, neutrons can study kinetics with time-resolution down to ca. 10ms for a recyclable experiment. Slow kinetics are also relevant, e.g. aging of wine; in geology, scientists conduct experiments over months or years.
- Many groups may be able to produce a recombinant protein, but if different groups require the same protein it could be shared. There may also be a need for the same material for different uses or techniques by groups working in non-competing fields. Encourage cross-disciplinary collaboration between groups in unrelated areas but with interest in e.g. same molecule.
- The development of consortia should be considered to develop research and solve problems in areas of mutual interest e.g. packaging, biopolymers, waste streams.
- A real collaboration is a two-way street that also shares resources; it should be multidisciplinary (e.g. share samples with NMR researchers)
- A win-win collaboration needs to be created: the win for a neutron facility can be
    - publications
    - public visibility (info for government)
    - impact can be defined as outreach, economics, training students.
    - IP issues may present problems
- Key conferences in food should be identified as location for future meetings or satellite meetings with inclusion of seminars or symposia:
    - IFT Annual Meeting & Food Expo brings together professionals who are involved in both the science and the business of food;
    - International Union of Food Science and Technology (IUFoST)
    - Food Colloids
    - International Hydrocolloids Conference
    - International Symposium on Food Structure and Rheology
- Workshops for food scientists on neutron scattering basics is desirable
- Special edition of food materials science journal dedicated to Neutron Scattering could engage and educate community
- Develop workshops that combines different techniques or skills, e.g. synchrotron, organic chemists (that understand what can be produced) NMR. The NMR community is larger in size and combined meetings would be attractive.
- Workshops would benefit from more potential users and industry people. There could also be short courses to address potential use.
- Regulatory bodies should get involved – start early dialogue because this is yet another ‘language’.
- Another meeting of this kind would be useful, possibly in Europe next year or a larger meeting in 2012.
- It might be good to have not only a meeting report but also a book aiming at people other than neutron scatterers. However, one should be aware that this is a more academic approach, because managers will not read books. “Industry needs three slides containing pictures and then a plan for profit.“

Access to large-scale facilities

- Proposal access systems could be reviewed; it is now 40 years old.
- Time line is important and 6 months for beam-time allocation is too long.
- Develop short calls for food industry people. Users would like to have (from facilities):
    - Possibility to test samples
    - Faster turn-around time
    - More on food and not only on soft matter
    - Include food-science community in peer review
    - Help food scientists to write competitive proposals.
- Deuteration resources are beneficial in addition to neutron resources. Some of the nuclear facilities have deuteration facilities but deuteration can be conducted in-house (i.e. outside a dedicated facility) if it is not too complicated. Larger molecules might be too time-intensive in a small lab, but smaller molecules such as sugars and lipids should be possible. While proteins can be deuterated to 90-95%, one needs to consider the biology and not just chemistry.
- Not all experimental aspects can be resolved before an experiment and often test time is needed to identify whether an experiment will work.
- While neutron scatterers have to help to interpret the data, they are unable to do this alone. Neutron scientists cannot do all the necessary experiments (and do not have the resources to do so) and need to collaborate with researchers that are equally committed to finding an answer i.e. there needs to be a mutual interest between partners. In addition, complementary techniques are essential as well as combining different neutron techniques, i.e. scattering and spectroscopy.
- When facilities reach out to new communities, there is a need to make sure that these proposals are successful. If a new user does not obtain some level of success the first time, they may not return, especially in the case of complex food systems.
- Neutron facilities should have scientific and programmatic proposals; it is important to have decent resource allocation for programmatic proposals. The US experience is that more money is available for energy and defence but very little money for food. A ‘Food Structure and Dynamics’ programme is supported within the Bragg Institute at ANSTO.
- Neutron facilities need to drive their own science and build partnerships. People spend time on projects and need to be engaged. There are issues around instrument scientists getting burnt out, lack of resources on both sides and a lack of commitment in time. The potential short-term collaborators (due to short-term contracts) need to be replaced by long-term projects including a large number of people in an interdisciplinary arena.
- Good outreach is important to promote “visible” experiments (e.g. red wine SANS on D11 at ILL). Government is also a stakeholder, especially for health and nutrition. Facilities might not play this card well enough, particularly with respect to the relationship between public health and industry. Consumers should also not be forgotten; consider the success of ‘molecular gastronomy’.
- Facilities should provide fact sheets (basic technological facts) for food industry and a list of techniques; essentially an identification of tools to use to solve problems in food science.

- There also needs to be some flexibility in the approach. The current pressure on industry is sustainability and this changes the importance and priorities. It would be wise for facilities to link to large ongoing topics.

Discussions continued during the workshop cruise on Sydney Harbour.

Recommendations

1. Model systems are important in understanding the behaviour and processes around food, including structural and dynamical measurements using various techniques (neutron, NMR, synchrotron, etc) combined with molecular-dynamics simulations. As real food-systems are generally highly complex, initial studies should focus on simple systems and working hypotheses could be tested. Subsequently, this will provide a better hypothesis for understanding real food processes.
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turn, is one step removed from industry. New collaborative approaches are needed.

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5. Further meetings are desirable. Key conference should be identified in food materials science into which either symposia could be included or satellites be associated.
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10. Neutron-scattering facilities may not be communicating their capabilities well enough in the areas of public health and industry. Facilities could provide fact sheets (basic technological facts) for the food industry, listing methods and example studies that can be utilised to solve problems in food science.

Media coverage

There were a number of interactions with media:

Radio:

- ABC 702 Sydney (Elliot Gilbert) – 1st Nov 2010
- ABC Townsville (Elliot Gilbert) – 29th Oct 2010
- ABC 666 Canberra (Ross Lee)
- 4BC Brisbane
- 2UE Sydney, ‘Afternoon Drive with the Two Murrays’ (Elliot Gilbert) – 29th Oct 2010

Print and web:

- Sydney Morning Herald: *'Smart packaging' on the horizon*, Danny Rose, 02 November 2010: http://news.smh.com.au/breaking-news-national/smart-packaging-on-the-horizon-20101102-17by8.html
- Cosmos Magazine: Heather Catchpole, *Packaging that really speaks to you*, 03 November, http://www.cosmosmagazine.com/news/3844/interactive-smart-packaging-horizon
- WA Today: *Nutrition benefits all part of the package*, Nicky Phillips, 03 November 2010: http://www.watoday.com.au/technology/technology-news/nutrition-benefits-all-part-of-the-package-20101103-17cph.html

- Sydney Morning Herald: *Nutrition benefits all part of the package*, Nicky Phillips, 03 November http://www.smh.com.au/technology/technology-news/nutrition-benefits-all-part-of-the-package-20101102-17cdn.html?from=smh_sb
- The Border Mail: *Nutrition benefits all part of the package*, Nicky Phillips, 03 November 2010: http://www.bordermail.com.au/news/national/national/general/nutrition-benefits-all-part-of-the-package/1986168.aspx
- The Age: *Nutrition benefits all part of the package*, Nicky Phillips, 03 November 2010: http://www.theage.com.au/technology/technology-news/nutrition-benefits-all-part-of-the-package-20101102-17cdn.html
- Packaging Suppliers and News: *Printable Electronics In 'Smart' Packaging*, 03 November 2010: http://www.packaging-int.com/news/printable-electronics-in-smart-packaging.html
- Tararua District Library: *Smart Packaging Your Book Cover*, 03 November 2010: http://tararualibrary.wordpress.com/2010/11/03/smart-packaging-your-book-cover/
- Packaging Magazine: *Nanotechnology could be key to the future of packaging*, 03 November 2010: http://www.packagingmag.com.au/news/nanotechnology-could-be-key-to-the-future-of-packa
- nambulaw.com: *Supermarket of the future*, 03 November 2010: http://nambulaw.com/technology/supermarket-of-the-future/
- Food Industry Association WA Inc: *Nutrition benefits all part of the package*, 05 November 2010*:* http://foodindustry.org.au/index.php?option=com_letterman&task=view&Itemid=107&id=97
- NZ Exporter: *Packaging that "talks" to consumers not far away*, 18 November 2010: http://nzexporter.co.nz/2010/11/packaging-that-talks-to-consumers-not-far-away/
- ABC Science: *My brain made me buy it*, Heather Catchpole, 06 December 2010: http://www.abc.net.au/science/articles/2010/12/06/3080675.htm
- MX Magazine Brisbane
- Food Magazine

Appendix

Institutions involved:

Organising institutions and sponsors:
ANSTO, Australia
AINSE, Australia
Nestle, Switzerland
European NMI3 network, various European countries
Joint Institute for Neutron Sciences, Oak Ridge National Laboratory, USA
Department of Industry, Innovation, Science and Research, Australian Government

Participating institutions:
ANSTO, Australia
CSIRO, Australia
Dairy Innovation Australia, Australia
Flinders University, Australia
University of Adelaide, Australia
University of Ballarat, Australia
University of Melbourne, Australia
University of Queensland, Australia
University of Guelph, Canada
Advanced Foods and Materials Network, Canada
Agrosup Dijon, Universite de Bourgogne, France
CEA/INRA, France
Institut Laue-Langevin (ILL), France
Montpellier SupAgro, France
Université de Bougogne, France
Hungarian Academy of Sciences (KFKI) Atomic Energy Research Institute (AEKI), Hungary
Sant Longowal Institute of Engineering & Technology, India
Institute of Agrarian Economics, Latvia
Delft University of Technology, Netherlands
NIZO food research, Netherlands
The University of Auckland, New Zealand
European Spallation Source, ESS, AB, Sweden
Lund University, Sweden
University of Fribourg, Switzerland
National Taiwan University, Taiwan
Kasetsart University, Thailand
Keele University, UK
Science and Technology Facilities Council (STFC), UK
University of Glasgow, UK
University of York, UK
Los Alamos National Laboratory, USA
National Institute of Standards and Technology (NIST), USA
Oak Ridge National Laboratory, USA
Packaging & Technology Integrated Solutions (PTIS), USA
Purdue University, USA
University of Tennessee, USA

Local organising committee

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Michael Zettinig, ANSTO

Programme

Programme

Day 1 - Monday, 1 November

9.00	Welcome by Adi Paterson, Chief Executive Officer, ANSTO Elliot Gilbert and Mike Davidson		
Introduction Chaired by- **Mike Davidson**			
9.15	Neutrons and food: what are the problems?	P. Lillford	University of York, United Kingdom
9.45	Neutron scattering – a natural tool for food science and technology research	E. Gilbert	ANSTO Bragg Institute, Australia
10.15	Discussion		
10.30	Morning tea sponsored by *Nestlé*		
Dairy session Chaired by- **Hans Tromp and Rex Hjelm**			
11.00	Quantitative models of casein micelle structure derived from SAXS and SANS	C. Holt	University of Glasgow, United Kingdom
11.30	Protein–lipid interactions at model membrane architectures	I. Koeper	Flinders University, Australia
11.50	Co–adsorption of β–casein and calcium phosphate nanoclusters (CPN) at hydrophilic and hydrophobic solid–solution interfaces studied by neutron reflectometry	T. Nylander	Lund University, Sweden
12.10	Discussion		
12.30	Lunch		
Lipids and fats session Chaired by- **Tommy Nylander and Anna Sokolova**			
13.30	Neutron scattering, hydrogenous materials and nutraceuticals	J. Katsaras	National Research Council, Canada
14.00	The effect of water on structuring of organic phases by mixtures of β–sitosterol and γ–oryzanol	W. Bouwman	Delft University of Technology, The Netherlands
14.20	Nanoaggregates of bile salt and cationic surfactant	J. Mata	ANSTO Bragg Institute, Australia
14.40	Discussion		
15.00	Afternoon tea		
15.30	Networking session		
17.00	Poster session		

Programme

Day 2 - Tuesday, 2 November

Protein and complexes session I

Chaired by- **Stephen Holt and Dominique Champion**

9.00	Neutron scattering studies of food structure: gelation, complexation and the effect of high pressure	R. H. Tromp	NIZO food Research, The Netherlands
9.30	The sweet taste of neutrons	S. Teixeira	Keele University, United Kingdom
9.50	Puroindoline binding to lipids and its relation to wheat endosperm structure	L. A. Clifton	ISIS Spallation Neutron Source, United Kingdom
10.10	Discussion		
10.30	Morning tea sponsored by *Nestlé*		

Protein and complexes session II

Chaired by- **Peter Lillford and John Katsaras**

11.00	Protein structure (SANS), water and protein dynamics (elastic and inelastic neutron scattering), and protein–lipids interface (neutron reflectivity)	C. Loupiac	Université de Bourgogne, France
11.30	Folding and dynamics of the digestive enzyme pepsin	D. Dee	University of Guelph, Canada
11.50	Antioxidant–protein interactions in phospholipid membranes	D. McGillivray	University of Auckland, New Zealand
12.10	Discussion		
12.30	Lunch		

Glassy states session

Chaired by- **Katy Wood and Susana Teixeira**

13.30	Protein structure and interactions in the solid state	S. Krueger	NIST, USA
14.00	Mobility in the vicinity of the glass transition: thermal and dynamical properties	D. Champion	Université de Bourgogne, France
14.20	The temperature and moisture dependence of protein dynamics in glycinin: a quasi–elastic neutron scattering study	A. Sokolova	ANSTO Bragg Institute, Australia
14.40	Discussion		
15.00	Afternoon tea		

Day 2 Programme continued next page →

Programme

Day 2 - Tuesday, 2 November continued

Food packaging and food safety session

Chaired by- **Susan Krueger and Jitendra Mata**

15.30	Need for neutron scattering techniques in packaging	R. Lee	PTIS, USA
16.00	Potential for neutron scattering in Food Safety	M. Davidson	University of Tennessee, Knoxville, USA
16.20	Discussion		

Plant materials session

Chaired by- **Herma Buttner and Ingrid Appelqvist**

16.40	Multi–scale structural characterisations of fatty acid multilayer tubes with temperature tunable diameter in bulk and at the air/water interface by coupling SANS and neutron reflectivity	A.L. Fameau	CEA/INRA, France
17.00	Discussion		
18.00	Depart from hotel to Pier 26, King St Wharf		
18.45	Embark for 19.00 departure		

Programme

Day 3 - Wednesday, 3 November

Digestion and metabolic processes session

Chaired by- **Duncan McGillivray and Al Paulson**

9.00	Bile physiology and physical chemistry in digestion: fundamental insights from small–angle neutron scattering	R. Hjelm	Los Alamos National Laboratory, USA
9.30	Starch granules under attack: multidisciplinary investigation of structural mechanisms governing starch digestion	J. Blazek	ANSTO Bragg Institute, Australia

Drinks and beverages session

Chaired by- **Wim Bouwman and Jaroslav Blazek**

9.50	Colloidal interactions involving condensed tannins in diluted systems: what problems can we solve through SANS?	A. Vernhet	Montpellier SupAgro, France
10.20	Discussion		

Where to from here?

Chaired by- **Rob McGreevy, Mike Davidson, Elliot Gilbert and Herma Buttner**

10.40	Open forum including morning tea
12.30	Lunch
13.30	Visit ANSTO