Glyco-Forum section

Meeting reports

Molecular Botany: Signals and the Environment

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The Annual Symposium of the Biochemical Society in 1993, recently held at The University of Leeds, was entitled ‘Molecular Botany: Signals and the Environment’. The organizers, Professor Dianna J. Bowles, and Drs Philip Gilmartin and Paul Knox, of the Centre for Plant Biochemistry and Biotechnology at Leeds, gained financial support from two Groups of the Society: the Carbohydrate Group, and the Nucleic Acid Group. Industrial sponsorship was also forthcoming from a number of international Plant Biotechnology Companies, including Monsanto, Schering and Unilever.

Glycobiology topics were found throughout the four-day Symposium, in which glycans as structural elements of the plant cell wall, and glycans as regulatory fragments derived from cell wall polysaccharides were discussed in depth.

Several speakers including Professor Joe Varner (St Louis), Keith Roberts (John Innes Institute) and Paul Knox (Leeds), described new data that are emerging on the organization of the primary cell wall. In this context, monoclonal antibodies specific for highly-defined glycan epitopes are increasingly used to map the plant cell surface, and in effect to elucidate the ‘molecular anatomy’ of the tissue. The patterns of glyco-conjugates, in particular, the arabino-galactan proteins (AGPs) can be used to predict cell-fate. It is currently an urgent issue to determine whether the developmental changes observed in the glycan epitopes of AGPs reflect turnover and modification within the cell or within the cell wall.

The primary wall is synthesized by cells still capable of expansion growth. This wall extends to accommodate increases in size of the protoplast it surrounds: the means by which extension can be regulated is a key question that has attracted interest for many years. Recent results from several laboratories indicate that the cross-bridges of xyloglucan linking separate cellulose microfibrils in the wall, may provide part of the answer to this question. For example, findings described by Dr Stephen Fry (Edinburgh) that fragments of xyloglucan are able to regulate extension growth induced by auxin, suggest the activity of the classical growth regulators and those of the oligosaccharides may be networked to co-ordinate the physiological response of the whole organism.

The Complex Carbohydrate Research Centre (CCRC) in Georgia, directed by Professors Peter Albersheim and Alan Darvill, has carried out pioneering studies for many years on the structural chemistry of the wall components. Professor Darvill and Dr Michael Hahn also from CCRC, provided an update on some of their recent studies. Both speakers focused on the structure and activity of ‘oligosaccharins’, their definition for oligosaccharides with regulatory activity. They discussed oligosaccharins derived from plant pectin polysaccharides, the oligagalacturonide class, and those derived from the wall of a plant fungal pathogen, the β-glucan class. Both classes are known to elicit defence responses when applied to plants, and there are now increasing data that the oligagalacturonides also act as endogenous growth regulators to affect developmental events and ultimately, morphogenesis. As yet however, it is unclear how and when the pectin polysaccharides of the wall fragment to produce ‘oligosaccharins’. Is it possible that fragmentation is not in fact necessary but rather, the oligagalacturonides are made as small units and secreted as such into the extracellular space?

The role of glycans in cell signalling events was also discussed by a number of speakers. Interestingly, the causal agent responsible for inducing nodules to form on the roots of legume plant species defined as a Nod factor, is a glycolipid. The glycolipids are synthesized and secreted by Rhizobia, and as described by Dr Jean Denerie (INRA, Toulouse) and Nick Brewin (John Innes Institute) can act as signals to induce the causal chain of events linking deformation of the root hairs of the epidermal layer, through to mitosis of cortical cells and organogenesis to form a nodule. This is a symbiotic relationship, in which the effect of colonization of the plant by the bacteria is beneficial. The glycolipid signal is produced by the bacteria and is presumably recognized by a receptor system of the plant. The existence of this molecular recognition event raises the question whether the bacterial signal mimics an endogenous signal and a receptor/signalling mechanism in everyday use by the plant. Dr Sacco de Vries (Wageningen) reported data to indicate that this may indeed be the case. Working with embryogenic cultures of carrot, his studies have shown that a class 4 endochitinase, may in some way be involved in the regulation of embryo formation. Antibodies that inhibit the catalytic activity of the endochitinase arrest clusters of carrot cells from developing into embryos. Very interestingly, the same effect can arise from the addition of a particular Nod factor glycolipid. These data take the potential significance of glycan hydrolases, such as the endochitinases, far beyond discussions of plant defence responses and into the centre stage of plant development.

The molecular mechanisms through which the glycans trigger changes in gene expression and morphogenetic events were also addressed. Professors Jean Guern (CNRS, Gif-sur-Yvette) and Dianna Bowles (Leeds) described their studies on the effects of glycan fragments on ion transport events at the cell surface. Professor Guern suggested that plant cells extract information from signal-induced pH transients, and showed, for example, that oligagalacturonides (dp 10—20) induced a rapid and transient acidification of the cytosol. Oligagalacturonides were also shown to depolarize the membrane potential, and suggestions were made that this glycan-induced change in membrane potential could be responsible for setting up a long-range systemic signalling mechanism in plants, involving moving action potentials propagated through electrically...
coupled cells. Interestingly, electrical events had also been detected by other workers in the very early stages of the interaction between the Nod factor glycolipid and the root hair cell of legumes.

The role of glycans in regulatory events was also discussed in a very different context by Professor Jeff Schell (MPI Cologne). He described data to suggest that the activity of the classical plant growth regulators, auxins and cytokinins, was modulated by their conjugation to sugars. Conjugation to a glycan affects both their biological activity and hydrophilic properties. Thus, addition and removal of the sugars by the relevant transferases and hydrolases could thereby represent a new mechanism of regulating the effects of the plant growth regulators at a particular place and time within the plant. The covalent attachment of glycans to a growth regulator was also described by Dr Dan Klessig (Rutgers) in the context of salicylic acid. This has recently been recognized as an important signalling molecule in plants: it is a weak acid able to cross hydrophobic barriers. In a manner similar to the auxins and cytokinins, the combined action of the β-glucosidase and glucosyl transferase, can be used to regulate levels of free SA in the extra- and intracellular compartments of the cell.

In all, the Symposium provided a good insight into the excitement that is around in plant glycobiology today. There is a growing awareness among plant scientists that glycans are of interest not only because of their fundamental structural role within the organism, but ever-more apparent, because of their central regulatory role in signalling and co-ordination.

Structure, Function and Synthesis of Glycoconjugates

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The joint Biochemical Society/Royal Society of Chemistry Carbohydrate Groups Spring meeting 1993 was held at the University of Dundee between 29 March and 1 April. The overall theme of the meeting was to bring together chemists and biochemists with interests in all aspects of carbohydrate research, in order to promote discussion and future collaboration.

The meeting began on the evening of 29 March, with the presentation of the Haworth medal to Professor T. Ogawa, followed by the Haworth Lecture. Professor Ogawa gave a masterful overview of his recent work, demonstrating just how much has been achieved in carbohydrate synthesis in recent years.

The morning session on Tuesday 30 March comprised two sessions on 'Chemistry and biochemistry of inositol', the former dealing mainly with synthetic aspects with presentations by Professors B. Potter, J. van Boom and Dr R. Gigg, and the latter on biochemical aspects with presentations from Professor P. Downes and Dr M. McConville. This session demonstrated perhaps more than any other how biochemistry can benefit from a significant input of synthetic organic chemistry. The afternoon session was devoted to structural analysis of glycans, with presentations from Drs E. Hounsell and D. Ashford. Dr Hounsell introduced a variety of modern techniques for the sequence analysis of glycans, and Dr Ashford demonstrated how such techniques combined can allow us to address important questions regarding site-specific glycosylation, using T cell-surface glycoproteins to illustrate the approach. The afternoon session was completed with the traditional student papers. Five student abstracts were chosen for presentation, from Ms Roslyn Bill (Oxford), Paul Fowler (Norwich), Nigel Halliday (Canterbury), Kenny Milne (Dundee) and Mark Probert (Edinburgh), and a prize was awarded for the best presentation, which was judged to be that of Paul Fowler.

The morning session of 31 March began with 'Molecular recognition I', with presentations by Professors Pamela Stanley, K. Drickamer and Dr S. Oscarson. This session spanned a variety of topics, from a detailed presentation on mammalian fucosyltransferases, through molecular mechanisms of carbohydrate recognition by animal lectins, to synthesis of disaccharide analogues to probe the binding specificity of plant lectins. The remainder of the morning session dealt with glycoside synthesis, beginning with the presentation of the Tate and Lyle medal to Dr T. Gallagher followed by the Tate and Lyle lecture, and presentations from Drs N. Turner and A. Nikolaev. This session further emphasized the great strides that are being made in carbohydrate synthesis, and introduced more recent approaches such as the use of glycosides 'in reverse' for the facile synthesis of specific glycosidic linkages. The afternoon session was devoted to conformational analysis, with presentations from Drs S. Perez and M. Gidley, and Professor A. Bush. A variety of approaches for conformational analysis was on show in this session, ranging from theoretical techniques to solid-state NMR. All three presentations demonstrated that conformational analysis of oligosaccharides is still far from routine, but that great improvements in both theoretical and experimental methodology had been gained, such that a steady flow of conformational data could be anticipated in the future. The evening of 31 March saw a very enjoyable conference dinner, with prizes for the student presentations ably awarded by Professor J. Brimacombe.

The final session on 1 April was entitled 'Molecular Recognition II', and included presentations from Professors O. Hindsaul and J. Lehnmann, and Dr R. Field. The central theme was glycosyltransferases, and the speakers ably demonstrated that the design of glycosyltransferase inhibitors was a worthwhile occupation, despite the lack of high-resolution structural data for any transferase under study.

The organizers wish to thank the 110 participants who collectively were responsible for an outstandingly successful meeting, to those who agreed to chair sessions, and lastly to the industrial sponsors without whom the meeting would not have taken place.

Meeting Announcements

Keystone Symposia on Molecular and Cellular Biology
Complex Carbohydrates in Biology and Medicine
Organizers: Jeffrey Winkelhake and Raymond Dwke
March 19–26, 1994; Frisco, Colorado, USA
For more information, please contact: Keystone Symposia, Drawer 1630, Silverthorne, CO 80498, USA
Phone: (303) 262-1230 Fax: (303) 262-1525.