ESF Euroglycoforum Research Networking Programme
Meeting Report Ref No 2895– Glycomarkers for Disease
Wierzba, Poland 12th – 17th September 2010

The meeting location was chosen to give opportunities for attendance for those from both Western and Central/Eastern Europe and was very successful in this respect with 23 participants from Central/Eastern Europe and 24 from Western Europe.

It was also an opportunity for younger scientists to meet and interact with experienced scientists and leaders in this field. The meeting was held at the conference centre of the Polish National Academy of Sciences in Wierzba which is situated at the heart of the Mazurian Lake District. The facilities were excellent and the location enabled participants to relax at the end of the day and to have informal discussion.

Photos courtesy of
Prof. Bozena Krotkiewska

Summary

A major problem presently faced by clinicians is in the accurate and timely diagnosis of disease. Confirmation of diagnosis based on symptoms and clinical examination frequently requires laboratory testing for disease markers. Several well recognised markers are available for various diseases but new markers which allow more precise or earlier diagnosis are being sought. Glycosylation is an event in which complex carbohydrates are synthesised often conjugated to other molecules such a protein or lipid and this process is known to change in several diseases. Such changes may take place quickly as the process is not directly under genetic control but influenced by a variety of environmental factors as well. It is therefore seen as a promising area to look for new disease markers.

Such markers may be the carbohydrates or glycans themselves or may be the enzymes for their synthesis or degradation. They may be found in tissues or frequently in body fluids which can make them more readily studies as markers. This workshop was aimed at seeing some of the latest development in the search for such disease markers, the ways in which they might be measured and their significance in diagnosis. It presented an opportunity to bring together clinicians and clinical and research scientists from a variety of disciplines. It was also an opportunity to enable younger scientists and students to meet key people in the field, to enable them to find out more about glycomarkers and to encourage them to work in this area.

A balanced programme with presentations from all these groups allowed interaction and participants came from a range of disciplines and countries. Poster and aural presentations from younger scientists were encouraged to allow them full participation in the meeting.

Although there have been presentations on carbohydrate disease markers at major meetings in the field of glycoscience this event was the first which was dedicated to studies of glycomarkers in disease and allowed studies a much greater range of markers to be presented. It was a timely event as there have recently been more detailed studies of many glycomarkers which now need to be carefully evaluated in terms of their clinical relevance. The range of talks allowed comparison between the different markers and the ways in which these have been studied. It was also a good chance to bring these recent studies to the attention of those not directly working in the field and especially to younger scientists and students who have keen interest in this area but want to know more about the range of markers and to become familiar with recent developments.

The size of the meeting was ideal for this purpose and the location allowed participants to concentrate on the subject and promoted interaction and discussion in a comfortable and relaxed atmosphere.

Scientific Content

The meeting covered a variety of aspects relating to the use of glycans or enzymes involved in their processing as markers for disease. The presentations ranged from those which considered screening through examination of serum for a number of different diseases to those where a detailed study of a specific marker for a given disease such as melanoma was evaluated.

Markers for a wide variety of diseases were presented which suggests that changes in glycosylation are common in disease but the challenge is to find the disease specific markers.

Glycomarkers in Serum

The initial talks were given by two leaders in the field of disease glycomarkers ; Pauline Rudd (UCD Dublin) and Carlito Lebrilla (UCDavis California) who concentrated on the changes in the oligosaccharides (glycans) found on secreted glycoproteins in relation to a number of diseases and alternative approaches to their study were presented. Pauline Rudd described how studies could be performed on serum samples where developments in hydrophilic interaction chromatography (HILIC) combined with capillary electrophoresis and mass spectrometry can be used to obtain a profile of all glycans from serum glycoproteins.. This gives quantitative information and is sensitive enough to be able to detect small changes in glycosylation that may appear at the onset of disease. Breast, Ovarian and Prostate cancers were all studied by this technique.

Carlito Lebrilla reported similar conclusions on changes in the profile of glycans from serum glycoproteins in relation to disease using different methodology. He described how the techniques may be developed to provide the high throughput required for screening patients for disease markers. Currently many disease markers are glycoproteins found in serum but it seems that rather than looking at the protein itself the glycans may in fact provide better disease markers. It was interesting to see the different approaches used and to compare the results obtained by each group looking at the same forms of cancer.

Markers in Urine

Studies reported by Terry Butters (Oxford) showed that urine also provides a convenient source of markers in this case urinary free oligosaccharides (FOS) have been developed to screen patients for altered protein and/or lipid glycosylation. As an example studies on hepatocellular carcinoma patients suggested FOS analysis could provide pro-inflammatory markers as early indicators of disease progression.

Enzyme Markers

The enzymes involved in glycan metabolism can also provide useful markers as discussed by Krzysztof Zwierz (Bialystok). Extensive studies in a number if diseases ranging from to

excessive alcohol consumption have shown exoglycosidases can provide convenient disease markers

Early stage Diagnosis

Carbohydrate markers for two diseases which are difficult to diagnose at an early stage which is required for successful treatment were described in presentations by Janush Popko (Bialystok) on joint diseases) and Jane Hewitt (Nottingham) on Muscular dystrophy. In the case of joint diseases the studies centred on enzymes responsible for degrading the glycans (exoglycosidases) which are found to be changed presumably as a result of processes leading to tissue destruction which suggest a relationship to disease progression with various forms of arthritis which could be beneficial, along with other tests in confirming early stages in the diseases. The ratios of the various enzymes change in different joint diseases and this could be useful for differential diagnosis. Some forms of muscular dystrophy are related to changes in the enzymes related to glycan biosynthesis rather than destruction. Genetic studies monitored by specific monoclonal antibodies on muscle biopsies. have shown recessive mutations in at least six genes (POMT1, POMT2, POMGnT1, Fukutin, FKRP and LARGE), several of which are known to play a role in synthesis of O linked mannose structures.

Infectious Disease Screening

The search for disease markers is not restricted to studies on patients. Several presenters showed that in the organisms involved in infectious diseases their glycosylation can be important in the severity and progress of the disease. Grażyna Palamarczyk (Warsaw) described how changes in glycosylation of the human fungal parasite Candida albecans could lead to a change from being a harmless commensurate parasite to one causing disease particularly in immunocomprimised individuals. In this case a basic mechanism for the addition of N-linked glycans the biosynthesis of the lipid moiety of the initial carbohydrate precursor transferred to the protein, dolichol, is disrupted. Two genes coding for essential enzymes in dolichol biosynthesis have been studied and could be targets for anti-fungal therapy. Another aspects of parasite glycosylation , its role in allergenicity was presented by Iain Wilson and Karin Hoffmann-Sommergrube (Vienna) . Studies have shown that glycosylation found on many parasites and allergens differs from that in humans and could induce allergenetic response. Although less well studied than response to protein allergens there is growing evidence that structures such as core α1,3-linked fucose moiety can be recognised by the immunoglobulin IgE which is involved in allergenetic response and could be helpful in providing allergen markers. Considering bacterial infections Julie Bouckaert (Brussels) showed how uropathogenic E.Coli can lead to urinary tract infections in diabetics and is mediated by the adhesion of type-1 fimbriae of the bacterium to specific mannose

containing structures. In this case a change in the carbohydrate receptor affinity can account for the increased susceptibility to infection of the diabetics.

O-linked Glycan Markers

Although many of the presentations considered the form of protein glycosylation known as N-linked glycosylation where the glycan is attached to certain asparagine residues on the peptide chain there is another type of glycosylation where glycans are attached to serine or threonine residues known as O-glycosylation. There are a number of differences both in the type of glycan and its density and distribution. Tony Corfield (Bristol) considered this type of glycosylation which is very common in the intestine where several types of highly O-glycosylated proteins known as mucins are found. It is apparent that these can form receptors for bacteria in the gut to a degree where the type of bacterial flora can be regulated by mucin glycosylation. In a process known as glycan legislation mucins on cells and secretions form a glyco-environment which provides ligands for enteric bacterial binding and which shows potential for mediation through mucin turnover. This process is dynamic and allows a rapid response to enteric bacterial and nutritional pressures and enables normal mucosal immune responses. These factors play a central role in gut homeostasis.

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Tumour Antigens

Several presentations were concerned with tumour antigens in various forms of cancer considering both the type of glycomarker that may be found and also the significance of changes in glycosylation to tumour progression. Data on two specific forms of cancer were presented; pancreatic cancer by Sławomir Dariusz Szajda (Bialystok) and on melanoma by Malgorzata Przybyło and Paweł Link-Lenczowski (Krakow). In pancreatic cancer currently two carbohydrate markers are used carbohydrate antigen 19-9 (CA 19-9) and carcino-embryonic antigen (CEA) but these are not ideal in terms of the sensitivity required for early detection which is essential for successful treatment. The studies reported at the meeting suggested that additional use of lysosomal exoglycosidase markers found in blood and urine could provide earlier diagnosis and as they can be measured using quite simple methodology could prove a valuable addition to current markers but this will require further validation. Studies on melanoma have shown that the glycosylation of the adhesion molecule N-cadherin undergoes a change in the type of complex N-glycans with increased branching being found. This was also noted for components of another adhesion protein integrin and suggests that the change in the glycan contributes to adhesion to extracellular matrix components, motility and invasive potential. Thus a consistent change in the glycosylation seems to be closely related to metastasis. Hans-Joachim Gabius (Munich) explained how changes in the glycosylation of tumour cells can provide a signal which is recognised by carbohydrate binding proteins

such as galectins where highly specific interaction can influence basic processes such as tumour growth providing a link between structure and function.

Techniques for studying glycomarkers

In considering disease markers it is obviously important that suitable techniques for rapid and sensitive detection are available. Insights into two such techniques were presented. Glycan microarray analysis was discussed by Sabine Flitsch, (Manchester) who showed how self-assembled monolayers (SAMs) of glycans on a gold support provide a very convenient means of screening for receptors enables rapid and sensitive detection of glycan binding proteins.. However attention must be paid to the way in which glycans are linked and in the preparation of the glycans for immobilisation. FACS analysis can also be applied as a screening technique as described by Claudine Keida (Orleans) who described application of the technique to study interaction of tumour cells with endothelial cells. Combining this with immufluorescence allowed the role of the Lewis X antigen to be determined. In addition combination with other techniques such as shear stress adhesion assays allows studies on chemokine glycosaminoglycan interaction and evaluation of tumor cell-endothelial cell mutual interactions taking place during the metastatic process. Thus detailed information on mechanisms and possible therapeutic intervention can also be obtained. The importance of glycosaminoglycans in biology was also highlighted by Cathy Merry (Manchester) who described how the key process of stem cell differentiation is associated with the evolution of specific cell lineages is associated with particular patterns of glycosaminoglycan (GAG) expression. Thus different types of GAGS send signals which determine the outcome of stem cell differentiation influencing the generation of different cell types.

Another interesting application of glycan markers was presented by Magdalena Orczyk-Pawiłowicz (Wroclaw). This presentation was concerned mainly with studies of changes in glycosylation in the foetus during pregnancy – any area not previously described in any detail and which could form the basis for markers in the future. During maturation of the foetus several changes were found. Several of these were located in the terminal regions of the glycans and detection of lectin binding activities suggested some possible functions for increased sialylation and fucosylation. These are known to be involved in interactions with receptors during tissue development and remodelling and also in immune modulation so could well be representing changes required when organs are formed and to prevent rejection by the maternal immune system. Finally Jean Claude Michalski (Lille) explained that the ability of glycans to provide a large number of different signals controlling cell interaction is important factor in the way in which neural connections are formed in the brain. Glycosylation influences various neuronal processes, such as neurite outgrowth and morphology, and may contribute to the molecular events that underlie learning and memory and their importance in such essential processes should not be overlooked.

Impact of the meeting

The meeting covered a number of areas with the common theme of disease markers related to glycosylation and proved valuable in bringing together those working in different fields to compare approaches and results.

The format of the meeting also allowed interaction between leading researchers in the field with those considering projects in this area or students wishing to learn more of the field.

The location attracted scientists from Central and Eastern Europe and also those from Western Europe and they were able to meet and discuss ideas and projects in an informal atmosphere.

The field of Glycoscience has seen considerable increase in knowledge of the structure and roles of glycosylated molecules in recent years and this has increased understanding of roles in many basic biological functions. It has been however difficult however to see how these might be related to many disease processes so the in depth examination of the relationship between the diseases and changes in glycosylation or processing enzymes presented at the meeting showed that although the mechanisms may still be unclear they can be useful as markers.

The meeting served to underline the wide application and interest in glycomics as a focus for the development of new biomarkers. This has arisen due to improved technology and its use in high throughput screening options to approach a wide range of diseases.

Talks ranged from descriptions of new and ongoing technology to the application of established methods in specific situations. The current strength of the glycomics field in Poland was emphasised through the participation of speakers from groups in Bialystok, Wroclaw, Warsaw, Cracow and Lomza.

Feedback from the meeting indicated that it was extremely well focussed with without overlap between the different lectures as regards scientific content. All the main aspects in the field of glycobiomarkers were thought to be fully covered : In particular the coverage of high throughput methodologies for discovering new markers in biological fluids (e.g. serum, urine, CNS) , diagnostic potential of glycobiomarkers , physiological implications of glycomarkers with respect to a vast range of pathologies (Cancer, Inflammation, neurological disorders, arthritis, cirrhosis, were considered to be excellent and provided valuable information on current progress and plans for future projects.

Others factors which contribute to the impact of the meeting were mentioned by participants as follows :-

- The Organisation was perfect : duration of lectures sufficient to cover the field and give opportunities to many participants to present their data including young scientists.
- The presentations were up to date and included much recent data .

- There were extremely active discussions sessions after the lecture leading to the emergence of new cutting-edge ideas .
- Suitable time was devoted to the poster session with participation of all of the presenters in front of posters . The idea of a price for the best poster was very stimulating for the students and create a real competition atmosphere between them
- The location place and accommodation were perfect , The Wierzba conference centre , is an excellent place for stimulating exchange between participants in a convivial atmosphere .
- Opportunities were given to the local Polish scientists to present their results at this International Meeting and their presentations were excellent .
- The size of the meeting, was just right to allow active exchange between participants and create new collaborations .

The general impression after the meeting was considered to be extremely positive , the main point being the extent and the diversity of the scientific content , which in many points highlighted fields which are not classically covered in other "glyco" meetings . This and the fact that it covered this topical area with participation from all over Europe should promote interest and developments of carbohydrate disease markers from existing and new research groups. Contacts made at the meeting will allow discussion between those from different disciplines especially those from clinical and biological research backgrounds.
The idea of holding a follow-up meeting in two years was discussed and there was considerable enthusiasm for this.

Co-sponsorship for this meeting was provided by the Biochemical Society in the UK and review articles by many of the speakers relating to this meeting are to be published in Biochemical Society Transactions Volume 39 part 1 (2011) . These will form an important addition resource for information on Glycomarkers for disease directly resulting from this workshop.

Meeting Participants

Convenors

Professor Sviatlana Astrautsova	Grodno, (BY)
Dr. Cathy Merry	Manchester, (UK)
Dr. Tony Merry	Manchester, (UK)
Professor Jean-Claude Michalski	Villeneuve d'Ascq , (FR)
Professor Grażyna Palamarczyk	Warsaw, (PL)
Professor Krzysztof Zwierz	Bialystok, (PL)

Speakers

Dr. Rotislav Bilyy	Lviv, (UA)
Dr. Julie Bouckaert	Brussels, (BE)
Dr. Terry Butters	Oxford, (UK)
Dr. Tony Corfield	Bristol, (UK)
Professor Sabine Flitsch	Manchester, (UK)
Professor Hans-Joachim Gabius	Munich, (DE)
Professor Jane Hewitt	Nottingham, (UK)
Dr. Karin Hoffmann-Sommergruber	Vienna, (AT)
Dr. Iwona Katnik-Prastowska	Wroclaw, (PL)
Professor Claudine Kieda	Orleans, (FR)
Professor Hubert Krotkiewski	Wroclaw, (PL)
Professor Carlito Lebrilla	Davis, (US)
Dr. Pawel Link-Lenczowski	Cracow, (PL)
Professor Ghislain Opdenakker	Leuven, (BE)
Dr. Magdalena Orczyk-Pawiłowicz	Wroclaw, (PL)
Professor Januusz Popko	Bialystok, (PL)
Dr. Malgorzata Przybyło	Cracow, (PL)
Professor Pauline Rudd	Dublin, (IE)
Dr. Slawomir Dariusz Szajda	Bialystok, (PL)
Professor Yvette van Kooyk	Amsterdam, (NL)
Dr. Napoleon Waszkiewicz	Bialystok, (PL)
Professor Iain Wilson	Vienna, (AT)

Participating Students

Dr. Fabritzia Chiodo	San Sabastien, (ES)
Ms. Sylwia Chojnowska	Bialystok, (PL)
Dr. Maria Lorna de Leoz	Davis, (US)
Ms. Anna Janic	Warsaw, (PL)
Mr. Chungsen Jin	Gotenberg, (SE)

Mr. Mateusz Juchimiuk	Warsaw, (PL)
Ms. Alina Kepka	Warsaw, (PL)
Ms. Kirstel Kodar	Talin, (EE)
Professor Bozena Krotkiewski	Wroclaw, (PL)
Dr. Oleg Kutenkov	Talin, (EE)
Mr. Marco Marradi	San Sabastien, (ES)
Dr. Alana Oluranti	Quito, (EC)
Ms. Katharina Pashinger	Vienna, (AT)
Dr. Vladimir Patoprsty	Bratislava, (SK)
Dr. Irina Pismenetskaya	Dniepropetovsk, (UA)
Dr. Napoleon Waszkiewicz	Bialystok, (PL)
Ms. Ewa Zatorska	Warsaw, (PL)

ESF EuroGlycoSciences Forum
Research Network Programme

Glycomarkers For Disease September 12th – 16th 2010

Conference Centre of the Polish National Academy of Sciences Wierzba, Poland

International Organising Committee	*Local Organising Committee*
Prof. Sviatlana Astrautsova (Grodno)	**Dr. Sylwia Chojnowska (Łomża)**
Prof. Grażyna Palamarczyk (Warsaw)	**Dr. Alina Kępka (Warsaw)**
Prof. Krzysztof Zwierz (Łomża)	**Prof. Janusz Popko (Białystok)**
Dr. Tony Merry (Manchester)	**Dr. Sławomir Dariusz Szajda (Białystok)**
Dr. Cathy Merry (Manchester)	**Dr. Napoleon Waszkiewicz (Białystok)**
Prof. Jean-Claude Michalski (Lille)	

Information

Location

The Conference Centre is located in the North - Eastern part of Poland in the heart of the Great Masurian Lake District

Transport from Warsaw to Wierzba

Transport is arranged from Warsaw (Institute of Biochemistry and Biophysics) to the Conference Centre in Wierzba on Sunday 12th September and returning on Thursday 16th September.

Conference Centre and Masurian Lake District

Varmia and Masuria are regions full of unique charm and magic with overwhelmingly beautiful nature. They are marked with plains, mountains, boulder fields, sparkling lakes and numerous rivers, streams and canals which combine to form a gigantic water network. The region is also rich in post-glacial knolls, mysterious coppices and immense forests. However, the unique flora and fauna are not the only characteristics to attract tourists. This land's long and stormy history is visible by the number and character of cultural monuments – from burial mounds dating back 2,500 years to old Prussian settlements, mysterious sacrificial altars and stone idols from pagan times. There are numerous historic monuments from the Middle Ages, the Renaissance and the Baroque right up to technical achievements of the 19th century. The Elbląg canal deserves special mention for its unique technological solutions. In the Rominicka Forests, so-called 'Emperor's Stones' attract much attention whereas the greatest attraction in the Borecka Forests are herds of European Bison. Also worth seeing are the complex of bridges in Stanczyki, a pyramid in Rapa, numerous religious sites and sanctuaries, fortifications from the First and Second World War in Gizycko, Gierloz and Mamerki, as well as scenic parks and nature reserves. The unique sites and rich history of this region promises a visit full of surprises.

Welcome to Varmia and Masuria – a land of a thousand lakes, wilderness and adventure.

All participants will stay in the conference centre and all sessions of the meeting will take place there.

MEETING PROGRAMME

Conference Centre of the Polish National Academy of Sciences, Wierzba, Poland.

SUNDAY 12TH SEPTEMBER (EVENING)

Welcome and informal reception/buffet.

Poster set-up, to remain for the entirety of the meeting

MONDAY 13TH SEPETMBER

Chair Prof. Krzysztof Zwierz (Łomża)

09.00 – 09.15	Introduction to the ESF Research Networking Programme Euroglycoforum **Prof. Sabine Flitsch, Manchester, UK**
09.15 – 09.45	Disease diagnosis based on protein glycosylation **Prof. Carlito Lebrilla, UC Davis, USA**
09.45 - 09.55	Discussion
09.55 – 10.25	Serum glycosylation profiles as disease markers **Prof. Pauline Rudd, NIBRT, Dublin, Ireland**
10.25 - 10.35	Discussion
10.35 – 11.05	Possible biological role of α(1,2)fucosylated fibronectin glycoform **Prof. Iwona Katnik-Prastowska, Wroclaw, Poland**
11.05 - 11.15	Discussion
11.15 – 11.40	**Coffee Break**
11.40 – 12.10	Therapeutic leukocyte deviation with an amylose-derivative and mechanism of action **Prof. Ghislian Opdenakker, Rega Institute, University of Leuven, Belgium**
12.10 - 12.20	Discussion
12.20 – 12.50	Glycoconjugate markers of joint diseases **Prof. Janusz Popko , Białystok, Poland**
12.50 - 13.00	Discussion
13.00 – 14.00	**Lunch**

Chair Prof Claudine Kieda (Orléans)

14.00 – 14.30	Glycomarkers for muscular dystrophy

	Prof. Jane Hewitt, Nottingham, UK
14.30 - 14.40	Discussion
14.40 – 15.10	The role of glycosylation for Candida albicans morphogenesis a pre-requisite for pathogenicity **Prof. Grażyna Palamarczyk, Warsaw, Poland**
15.10 - 15.20	Discussion
15.20 – 15.50	Glycan Legislation in the human intestine. O-Glycan markers for Mucosal Protection, **Dr. Tony Corfield, Bristol UK**
15.50 – 16.00	Discussion
16.00 – 16.30	**Coffee Break**
16.30 – 17.00	Carbohydrate markers of pancreatic cancer **Dr. Sławomir Dariusz Szajda, Białystok, Poland**
17.00 - 17.10	Discussion
17.10 – 17.40	Terminal monosaccharide expression on some amniotic glycoproteins as a biomarker of fetus maturity **Dr. Magdalena Orczyk-Pawiłowicz, Wroclaw, Poland**
17.40 - 17.50	Discussion
17.50 – 18.20	Sweet signs of apoptotic death **Dr. Rostyslav Bilyy, Lviv, Ukrane**
18.20 – 18.30	Discussion

TUESDAY 14TH SEPTEMBER

Chair Prof. Jean-Claude Michalski (Lille)

09.00 – 09.30 Glycan micro arrays a new tool for disease screening
Prof. Sabine Flitsch, Manchester, UK

09.30 - 09.40 Discussion

09.40 – 10.10 Glycan changes on Tumor antigen and its relation to Dendritic cells
Prof. Yvette van Kooyk, Amsterdam, Netherlands

10.10 - 10.20 Discussion

10.20 – 10.50 Brain glycans - functions in memory and markers of neuropathologies
Prof. Jean-Claude Michalski, Lille, France

10.50 - 11.00 Discussion

11.00 – 11.30 **Coffee Break**

11.30 – 12.00 Urinary tract infections in diabetics, the story of uropathogenic E. coli
Dr. Julie Bouckaert, Belgium

12.00 - 12.10 Discussion

12.10 – 12.40 Carbohydrate moiety of serum IgG in rheumatoid and psoriatic arthritis during clinical treatment
Prof. Hubert Krotkiewski, Wroclaw, Poland

12.40 - 12.50 Discussion

13.00 – 14.00 **Lunch**

Chair Prof. Grażyna Palamarczyk (Warsaw)

14.00 – 14.30 Carbohydrate Antigens of Allergens and Parasites
Prof. Iain Wilson, Vienna, Austria

14.30 - 14.40 Discussion

14.40 – 15.10 Glycoallergens and their Application in Allergy diagnosis
Dr. Karin Hoffmann-Sommergrube, Vienna, Austria

15.10 - 15.20 Discussion

15.20 – 15.50 **Break**

15.50 – 16.20 Glycoconjugate markers of alcohol abuse

	Dr. Napoleon Waszkiewicz, Białystok, Poland
16.20 - 16.30	Discussion
16.30 – 17.00	Glycans in melanoma screening; part 1
	Dr. Małgorzata Przybylo, Cracow, Poland
17.00 - 17.10	Discussion
17.10 – 17.40	Glycans in melanoma screening; part 2
	Dr. Pawel Link-Lenczowski, Cracow, Poland
17.40 - 18.00	Discussion

Evening Panel discussion session

WEDNESDAY 15TH SEPTEMBER

Chair Prof. Sviatlana Astrautsova (Grodno)

09.00 – 09.30	The Cellular Microenvironment and Cell Adhesion: a Role for O-Glycosylation. **Dr. Kelly Ten-Hagen, NIH, Washington, USA**
09.30 - 09.40	Discussion
09.40 – 10.10	Glycosaminoglycans as regulators of stem cell differentiation. **Dr. Cathy Merry, Manchester, UK**
10.10 - 10.20	Discussion
10.20 – 10.50	FACS for evaluation of glycan-mediated adhesive interactions of tumor cells with endothelial cells. **Prof. Claudine Kieda, Orléans, France**
10.50 - 11.00	Discussion
11.00 – 11.30	**Coffee Break**
11.30 – 12.00	Urinary glycan markers for disease **Dr. Terry Butters, Oxford, UK**
12.00 - 12.10	Discussion
12.10 – 12.40	Glycans as functional markers in malignancy: the galectin connection **Prof. Dr. Hans-J. Gabius, Munich, Germany**
12.40 - 12.50	Discussion
12.50 – 13.20	Glycosidases as markers for many diseases **Prof. Krzysztof Zwierz, Łomża, Poland**
13.20 - 13.30	Discussion
13.30 – 14.30	**Lunch**

Afternoon Excursion – Tour of the The Mazurian Lake District

20.00	Meeting banquet

THURSDAY 16TH SEPTEMBER

Close of meeting