Dear Participants,

We are very pleased to welcome you this year in Nancy for the Occupational Allergies Conference. It is the third in a series of conferences organised by the French Research and Safety Institute for the Prevention of Occupational Accidents and Diseases (INRS). This round of conferences, devoted to occupational health research, is centred this year on work-related allergies. It is being organised in partnership with the European PEROSH (Partnership for European research in Occupational Safety and Health) network.

Hundreds of substances, present in the work environment, are currently known for their allergenicity and the list grows each day. With substitution currently being the preferred method of prevention, it is essential beforehand to investigate the allergenicity of the substitutes. The same applies to new products placed on the market. When substitution by a non-hazardous product is not possible, it is important to know, or to predict for new substances, the pathways and immunological phenomena in order to optimise worker protection by collective or individual prevention measures.

Allergies are disorders which are generally not perceived as a serious concern. Rarely fatal, they are often considered to be part and parcel of the job. However, they generally develop very early in working life and affect workers for a very long time, often forcing them to change jobs. In unfavourable economic contexts, this may lead workers to deny their illness for fear of becoming unemployed. This, in addition to the fact that the sectors mostly affected by allergy risk – hairdressing, bread and pastry-making for example – are often made up of micro-enterprises/SMEs in which reclassification is almost impossible.

The Occupational Allergies 2013 Conference will provide the opportunity to address most of these questions during the different sessions covering the fields of medicine, epidemiology, chemistry, immunology, toxicology, metrology and prevention. During the two and a half days, young researchers and experienced experts will present the international community’s current considerations and work on occupational allergies.

We hope that this Conference will shed light on occupational allergy issues and restore the importance that this topic deserves. We sincerely thank all those who have worked towards making this event a success: members of the Organisation and Planning Committee, the International Scientific Committee, invited speakers and session chairpersons. We hope you enjoy the Conference as well as your stay in Nancy.

Yours sincerely,

The Chairmen of the Occupational Allergies 2013 Conference

Guy Hédelin
Division Head at INRS

Didier Baptiste
Scientific Director, INRS

Chairman of the PEROSH network
SUMMARY

COMMITTEES 3

PROGRAMME 6 - 11

OPENING SESSION 12

SESSION I: EPIDEMIOLOGY 15
  Oral presentations 16 - 22

SESSION 2: METROLOGY 23
  Oral presentations 24 - 30

SESSION 3: TOXICOLOGY AND BIOMETROLOGY 31
  Oral presentations 32 - 38

SESSION 4: PREVENTION 39
  Oral presentations 40 - 44

POSTERS 45
  Posters 46 - 63

AUTHOR INDEX 64 - 66
COMMITTEES

Conference Co-Chairs

Didier Baptiste, INRS Scientific Director
Guy Hedelin, Head of the Occupational Epidemiology Division, INRS

INRS Organising Committee

Dominique Mur
Chantal Rolin
Stéphane Vaxelaire

INRS Scientific Committee

Fabrice Battais
Valérie Demange
Philippe Duquenne
Jean-Raymond Fontaine
François Gagnaire
Annabelle Guilleux

Guy Hedelin
Jean-Bernard Henrotin
Nadia Nikolova-Pavageau
Isabelle Sponne
Alain Simonnard

International Advisory Committee

Harri Alenius
Dominique Choudat
Wijnand Eduard
B. Jean Meade
Manon Labrecque
Jean-François Nicolas
Marc Pallardy
Christophe Paris
John Saunders

Finnish Institute of Occupational Health, Topeliuksenkatu 41 aA, FIN-00250 Helsinki, FI
Cochin Hospital, AP-HP, Department of occupational diseases, Paris Descartes University, 27 rue Faubourg Saint-Jacques, 75014 Paris, FR
National Institute of Occupational Health, Statens Arbejdsmiljøinstitutt, PB 8149 Dep., N-0033 Oslo, NO
National Institute for Occupational Safety and Health, 1095 Willowdale Dr, MORGANTOWN, WV 26506, USA
Hôpital du Sacré-Coeur de Montréal, Université de Montréal, Montréal (Québec), CA
Lyon 1 University, UFR Lyon Sud, IFR128, University Hospital Network of Lyon, INSERM U851, 21 Avenue Tony Garnier, 69365 Lyon Cedex 07, FR
INSERM UMR 996, Faculty of Pharmacy, University Paris-Sud, 92296 Châtenay-Malabry, FR
Occupational Pathology Consultation Centre, Inserm U954 - Nutrition, Genetics and Exposure to Environmental Hazards, Faculty of Medicine, 9 rue de la Forêt de Haye - 54505 Vandœuvre-Lès-Nancy, FR
Health and Safety Laboratory (HSL), Harpur Hill, Buxton, Derbyshire SK17 9JN, UK
Professor Harri Alenius is an internationally recognized immunologist and immunotoxicologist with extensive experience in exploring immunotoxic effects of fungal spores, wood dust particles and engineered nanoparticles. Currently:
- Research Professor;
- Head, Systems Toxicology Unit;
- Vice-director, Nanosafety Research Center at Finnish Institute of Occupational Health
Author of more than 138 publications, collaborated with more than 370 co-authors since 1992.

Professor Dominique Choudat
University Professor – Hospital practitioner in occupational medicine, Paris Descartes University, Cochin-Broca-Hôtel Dieu hospital group, AP-HP
Teaching activities
Teaching activities concern medical students, interns in occupational medicine and other specialties and paramedical staff.
Other university functions
Member of the National Universities Council
Member of the Teaching Committee, Faculty of Medicine, Paris Descartes University
Advisor to the Medical Internship Examination Board
Coordination of the Preventive Medicine Unit at the Paris Descartes University
Research activities
Clinical research work is focused in particular on flour-induced occupational asthma, ionising and non-ionising radiation, the association between exposure to pollution and the onset of disease.
Hospital activities
Occupational Disease Department (Cochin), Department Head since 2002. The goal of this Department is to specify the diagnosis of occupational and environmental diseases, as well as give opinions on risk prevention, medical fitness and career guidance with a view to improving medical and social care.

Professor Wijnand Eduard is research director at the National Institute of Occupational Health of Norway. The main focus of his research is on health risks from bioaerosol exposure in working populations including development of measurement methods for microbiological agents, epidemiological and exposure studies in various occupations including sawmill workers, farmers and waste handlers. He has supervised MSc and PhD students in exposure assessment of biological and chemical agents, serves on editorial boards of 2 scientific journals and is author of more than 80 publications in peer-reviewed journals.

Professor Jean-François Nicolas
- Université Lyon 1, Faculty of Medicine Lyon-Sud, INSERM U 1111
- Clinical allergology and immunology, Centre Hospitalier Lyon Sud
Dr Nicolas is a dermatologist and co-head of the Allergology and Clinical Immunology Department of the Lyon University Hospital. He is also an immunology professor and director of an INSERM research team investigating “Immunology of skin allergy and vaccination”. Their research activities cover the skin’s immune system, in particular the study of cell and molecule signalling which activates immune responses or tolerance to skin antigens and allergens. The research is applied to cutaneous inflammatory diseases in humans (eczemas and drug allergies) as well as pre-clinical models of these diseases in mice and studies on the different dermal routes for vaccine administration in order to improve the overall effectiveness of vaccines. Dr Nicolas has written and/or co-written over 150 research articles and book chapters. He is also the co-editor of the European Journal of Dermatology.
**Professor Marc Pallardy**
Vice-Dean and research director, Faculty of Pharmacy, University Paris-Sud
Head INSERM UMR-S 996 “Cytokines, chemokines and immunopathology”
President of the French society of « Cellular pharmacology and toxicology» (SPTC)
Associate editor of "Toxicological Sciences" and "Journal of Immunotoxicology"
82 publications in international peer-reviewed journals.

**Professor Christophe Paris, MD, PhD**
University Professor – Hospital Practitioner, Faculty of Medicine, University of Lorraine, Nancy 1, since 2003
Head of the Occupational Disease Consultation Centre (Philippe Canton Building, Medical Specialties Unit 1, Nancy University Hospital)
Head of the research team on gene-environment interaction and health effects (INGRES)
Author of about 60 publications

**Professor John Saunders** is an applied scientist with a background in scientific research and development. He is currently leader of the Exposure and Control team within the Occupational Hygiene Unit at HSL. He has over 25 years' experience in the field of ventilation. During this time he has gained extensive knowledge of a wide range of local exhaust ventilation systems, ranging from laboratory fume cupboards to industrial spray booths. Of particular interest is the use of tracer gas techniques to characterize ventilation systems. John has used this technique to evaluate the effectiveness of containment systems, including fume cupboards and also to calculate effectiveness of indoor ventilation systems. John is also a member of several CEN committees dealing with industrial ventilation and filtration.
# PROGRAMME

**Wednesday 3 April**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:30</td>
<td>Registration and coffee</td>
</tr>
<tr>
<td>10:00</td>
<td><strong>Opening session</strong>&lt;br&gt;Stéphane Pimbert, INRS Director General&lt;br&gt;Didier Baptiste, INRS Scientific Director, PEROSH Chairman&lt;br&gt;Guy Hédelin, Head of Epidemiology Division, INRS</td>
</tr>
</tbody>
</table>
| 10:30 | Invited speaker: Marc Pallardy, University Paris-Sud, Chatenay-Malabry, FR  
*Chemical allergies: from the clinic to the mechanisms* |
| 11:15 | Invited speaker: Harri Alenius, FIOH, Helsinki, FI  
*Prediction of allergenic potential of chemicals* |
| 12:00 | Invited speaker: Dominique Choudat, AP-HP, Descartes University, Paris, FR  
*Respiratory allergies: from physiopathology to prevention* |
| 12:45 | Lunch / Posters                                                        |

## Session 1: EPIDEMIOLOGY (1)

*Chairmen: Dominique CHOUDAT, AP-HP, France & Guy HEDELIN, INRS, France*

### ORAL PRESENTATIONS

<table>
<thead>
<tr>
<th>Time</th>
<th>Speaker</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
</table>
| 14:00 | Invited speaker: Christophe Paris, University Hospital, Vandœuvre-lès-Nancy, FR  
*Emergence of occupational allergies and current trends in Europe* | 16 |
| 14:45 | Invited speaker: V. Dorrido, IST, Lausanne, CH  
*Respiratory effects of an exposure to grain dust among grain workers in the Vaud region (Switzerland)* | 17 |
| 15:05 | Invited speaker: P. Marraccini, Milan Hospital, Milan, IT  
*Baker’s asthma: inflammatory markers of occupational exposure to flour dust* | 18 |
| 15:25 | Invited speaker: M. Gonzalès, University Hospitals, Strasbourg, FR  
*Asthma among workers in healthcare settings: role of disinfection with quaternary ammonium compounds* | 19 |
| 15:45 | Questions & Answers                          |                                                                      |      |
| 16:00 | Coffee break / Posters                       |                                                                      |      |
### Session 1: EPIDEMIOLOGY (2)
Chairmen: Christophe PARIS, CHU, France & Guy HEDELIN, INRS, France

<table>
<thead>
<tr>
<th>Time</th>
<th>Presentation</th>
<th>Page</th>
</tr>
</thead>
</table>
| 16:30 | Is the incidence of aliphatic amine-induced occupational rhinitis and asthma underestimated?  
H. Laborde-Castérot, University Hospitals Saint-Louis Lariboisière Fernand-Widal, Paris, FR | 21   |
| 16:50 | Characterising work-related dermatosis resulting from contact allergy to proteins  
A. Barbaud, University Hospital, Vandoeuvre-lès-Nancy, FR | 22   |
| 17:10 | Questions & Answers                                                           |      |
| 17:20 | Poster Session                                                                |      |
| 18:15 | Welcome cocktail party                                                        |      |

### Thursday 4 April

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:30</td>
<td>Registration</td>
</tr>
</tbody>
</table>

### Session 2: METROLOGY
Chairmen: Philippe DUQUENNE INRS, France & Wijnand EDUARD, NIOH, Norvège

<table>
<thead>
<tr>
<th>ORAL PRESENTATIONS</th>
<th>Page</th>
</tr>
</thead>
</table>
| 9:00 Invited speaker: Wijnand Eduard, NIOH, Oslo, NO  
*Health risks and occupational exposure to microbial allergens, a complex relationship* | 24   |
| 9:45 Monitoring exposure to soya aeroallergens during dockside unloading  
H. Mason, HSL, Buxton, UK | 25   |
| 10:05 Monitoring exposure to microbial enzymes used to clean endoscopes  
I. Smith, HSL, Buxton, UK | 26   |
| 10:25 Questions & Answers                                                          |      |
| 10:40 Coffee break / Posters                                                      |      |
| 11:10 Sampling strategy and specific detection of the airborne allergens tropomyosin and arginine kinase detected in the crustaceans plants located in the Province of Québec  
S. Gagné, IRSST, Montreal, CA | 27   |
| 11:30 Occupational exposure to airborne allergenic fungi in green coffee factories  
H. Niculita-Hirzel, IST, Lausanne, CH | 28   |
| 11:50 High resolution microscopic characterization of submicronic fragments generated from Apergillus fumigatus cultures  
A.K.J. Afanou, NIOH, Oslo, NO | 29   |
<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Speaker/Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>12:10</td>
<td>Setting indicative guidance values for exposure to laboratory animal allergens?</td>
<td>H. Mason, HSL, Buxton, UK</td>
</tr>
<tr>
<td>12:30</td>
<td>Questions &amp; Answers</td>
<td></td>
</tr>
<tr>
<td>12:45</td>
<td>Lunch</td>
<td></td>
</tr>
</tbody>
</table>

**Session 3: TOXICOLOGY AND BIOMETROLOGY (1)**
Chairmen: Harri ALENIUS, FIOH, Finland & Jean-François NICOLAS, Lyon 1 University, France

**ORAL PRESENTATIONS**

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Speaker/Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>14:00</td>
<td>Invited speaker: Jean-François Nicolas, Lyon 1 University, Lyon, FR</td>
<td>Immunology of allergic contact dermatitis</td>
</tr>
<tr>
<td>14:45</td>
<td>Regulatory support for respiratory and skin sensitizers</td>
<td>C. Rousseau, N. Printemps, ANSES, Maisons-Alfort, FR</td>
</tr>
<tr>
<td>15:05</td>
<td>Ranking of epoxy resin compounds based on their sensitising potency</td>
<td>K. Heine, Research and Advisory Institute for Hazardous Substances (FoBiG), Freiburg, DE</td>
</tr>
<tr>
<td>15:25</td>
<td>The role of the transcriptional factor Nrf2 in contact hypersensitivity</td>
<td>Saadia Kerdine-Römer, Paris-Sud University, Châtenay-Malabry, FR</td>
</tr>
<tr>
<td>15:45</td>
<td>Questions &amp; Answers</td>
<td></td>
</tr>
<tr>
<td>16:00</td>
<td>Coffee break / Posters</td>
<td></td>
</tr>
</tbody>
</table>

**Session 3: TOXICOLOGY AND BIOMETROLOGY (2)**
Chairmen: Marc PALLARDY, INSERM U461, France & Alain SIMONNARD, INRS, France

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Speaker/Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>16:30</td>
<td>Identifying allergens in manufactured products</td>
<td>E. Langlois, INRS, Vandoeuvre-lès-Nancy, FR</td>
</tr>
<tr>
<td>16:50</td>
<td>Exhaled breath condensate as a suitable matrix to assess airway dose and effects of occupational exposure to beryllium and beryllium compounds</td>
<td>S. Hulo, Lille-Nord de France University, Lille, FR</td>
</tr>
<tr>
<td>17:10</td>
<td>Questions &amp; Answers</td>
<td></td>
</tr>
<tr>
<td>17:30</td>
<td>End of the day</td>
<td></td>
</tr>
<tr>
<td>20:00</td>
<td>Conference dinner</td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>Activity</td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>-----------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>8:30</td>
<td>Registration</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Session 4 : PREVENTION</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Chairmen: Jean-Raymond FONTAINE &amp; John SAUNDERS, HSL, UK, INRS, France</em></td>
<td></td>
</tr>
<tr>
<td>9:15</td>
<td>Invited speaker: John Saunders, HSL, Buxton, UK</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>The use of local exhaust ventilation for controlling airborne allergens in the workplace and a comparison of industry approaches</em></td>
<td></td>
</tr>
<tr>
<td>10:00</td>
<td>Developing a method to assess emission levels from machines used in bakeries</td>
<td></td>
</tr>
<tr>
<td></td>
<td>F. Bonthoux, INRS, Vandœuvre-lès-Nancy, FR</td>
<td></td>
</tr>
<tr>
<td>10:20</td>
<td>What factors influence the dustiness and exposure to allergens in bakery improver mixtures?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>S. Fraser, HSL, Buxton, UK</td>
<td></td>
</tr>
<tr>
<td>10:40</td>
<td>Questions &amp; Answers</td>
<td></td>
</tr>
<tr>
<td>10:50</td>
<td>Coffee break / Posters</td>
<td></td>
</tr>
<tr>
<td>11:15</td>
<td>From the emerging risk to reducing occupational exposure - Case of nitrogen trichloride in swimming pools</td>
<td></td>
</tr>
<tr>
<td></td>
<td>F. Gérardin, INRS, Vandœuvre-lès-Nancy, FR</td>
<td></td>
</tr>
<tr>
<td>11:35</td>
<td>How reducing exposure impacts allergic diseases: comparison of national preventive approaches in the UK and France</td>
<td></td>
</tr>
<tr>
<td></td>
<td>L. Bensefa-Colas, Cochin University Hospital, Paris, FR</td>
<td></td>
</tr>
<tr>
<td>11:55</td>
<td>Questions &amp; Answers</td>
<td></td>
</tr>
<tr>
<td>12:05</td>
<td>Closing session</td>
<td></td>
</tr>
<tr>
<td>12:20</td>
<td>End of the Conference</td>
<td></td>
</tr>
<tr>
<td>Posters</td>
<td>Page</td>
<td></td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>------</td>
<td></td>
</tr>
<tr>
<td><em>Iron oxide particles modulate the ovalbumin-induced Th2 immune response in mice</em>&lt;br&gt;Ban M., INRS, Vandœuvre-lès-Nancy, FR</td>
<td>46</td>
<td></td>
</tr>
<tr>
<td><em>Submicron and nanomicron iron-oxide particles affect pulmonary immunity in mice</em>&lt;br&gt;Ban M., INRS, Vandœuvre-lès-Nancy, FR</td>
<td>47</td>
<td></td>
</tr>
<tr>
<td><em>The occupational dermatology atlas: an image-based prevention tool</em>&lt;br&gt;Bensefa-Colas L., Cochin University Hospital, Paris, FR</td>
<td>48</td>
<td></td>
</tr>
<tr>
<td><em>Allergenic airborne Penicillium species: a DNA sequence-based and bioinformatic study</em>&lt;br&gt;Davolos D., INAIL, Rome, IT</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td><em>Respiratory health and working conditions in composting facilities</em>&lt;br&gt;Demange V., INRS, Vandœuvre-lès-Nancy, FR</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td><em>Factors affecting concentrations of thermophilic microorganisms and endotoxins in composting facilities</em>&lt;br&gt;Duquenne P., INRS, Vandœuvre-lès-Nancy, FR</td>
<td>52</td>
<td></td>
</tr>
<tr>
<td><em>Hypersensitivity pneumonitis in a cluster of sawmill workers: a 10-year follow up of exposure, symptoms and lung function</em>&lt;br&gt;Færden K., National Institute of Occupational Health, Oslo, NO</td>
<td>53</td>
<td></td>
</tr>
<tr>
<td><em>Inhalation exposures to respiratory sensitizers and irritants among professional cleaning workers</em>&lt;br&gt;Gerster F., Institute for work and Health, Lausanne, CH</td>
<td>54</td>
<td></td>
</tr>
<tr>
<td><em>Contact and respiratory sensitizers can be distinguished by IL-4 receptor alpha expression and IL-2 production</em>&lt;br&gt;Goutet M., INRS, Vandœuvre-lès-Nancy, FR</td>
<td>55</td>
<td></td>
</tr>
<tr>
<td><em>First evidence of occupational asthma induced by argan powder</em>&lt;br&gt;Paris C., University Hospital, Vandœuvre-lès-Nancy, FR</td>
<td>56</td>
<td></td>
</tr>
<tr>
<td><em>An epidemic of allergic contact dermatitis in a metalworking shop</em>&lt;br&gt;Penven E., University Hospital, Nancy, FR</td>
<td>57</td>
<td></td>
</tr>
<tr>
<td><em>Comparison between exhaled breath condensate and urine to assess occupational exposure to beryllium</em>&lt;br&gt;Radauceanu A., INRS, Vandœuvre-lès-Nancy, FR</td>
<td>58</td>
<td></td>
</tr>
<tr>
<td><em>Protecting against exposure to moulds and thermophilic actinomycetes when operating a front-end loader in composting facilities</em>&lt;br&gt;Schlosser O., Suez Environnement, CIRSEE, Le Pecq, FR</td>
<td>59</td>
<td></td>
</tr>
<tr>
<td>Title</td>
<td>Page</td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>------</td>
<td></td>
</tr>
<tr>
<td>Validation of an analytical technique to assay urinary chromium by atomic absorption spectroscopy (AAS)</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td><strong>Sedjelmaci N.</strong>, Toxicology Laboratory, University Hospital, Bab El Oued, Alger, DZ</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sampling and quantification of airborne antigenic/allergenic proteins from moulds</td>
<td>61</td>
<td></td>
</tr>
<tr>
<td><strong>Stephan U.</strong>, BMA-Labor GbR, Bochum, DE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preventing occupational skin diseases in hairdressing: three experiments in the Franche-Comté region</td>
<td>62</td>
<td></td>
</tr>
<tr>
<td><strong>Thiébaut A.</strong>, University Hospital, Besançon, FR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hand dermatitis among healthcare workers: the role of isothiazolinones in hospital soaps</td>
<td>63</td>
<td></td>
</tr>
<tr>
<td><strong>Tran N.</strong>, Avicenne University Hospital, Paris Seine-Saint-Denis, FR</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
OPENING SESSION

Marc Pallardy, University Paris-Sud, Chatenay-Malabry, FR
Chemical allergies: from the clinic to the mechanisms

Harri Alenius, FIOH, Helsinki, FI
Prediction of allergenic potential of chemicals

Dominique Choudat, AP-HP, Descartes University, Paris, FR
Respiratory allergies: from physiopathology to prevention
The skin plays a major role in acting as a physical, immune and sensing barrier to chemicals in our environment that we may become exposed to. Such chemicals include those that may be absorbed into the skin accidentally after environmental or occupational exposure or, in the case of a cosmetic or dermatological settings, applied to the skin deliberately.

Skin sensitization induction is a multi-stage process. Whether or not, and to what degree, exposure to a particular compound will result in skin sensitization, is dependent on:

1) translocation of the sensitizer from the skin surface to the epidermal site of action. This depends on the dose given and duration of exposure, but is not strongly dependent on the chemical nature of the sensitizer;

2) covalent reaction of the sensitizer with skin protein. This is strongly dependent on the chemical nature of the sensitizer, in particular electrophilic reactivity and hydrophobicity. The nature of the skin protein involved in this process is not established: possibilities range from any protein encountered in the skin to highly nucleophilic proteins associated with epidermal Langerhans cell membranes.

In this presentation recent developments in the prediction of allergenic potential of chemicals by in vivo, in vitro and in silico methods will be reviewed. In vitro tests include binding assays between chemicals and standard receptor molecules based on benchmarking with chemicals known not to be sensitizing. The most standardised in vivo method used today, to establish the sensitizing potency of chemicals, is the local lymph node assay (LLNA). In silico tests represent computer identifications of chemical structures known to be present in contact sensitizing chemicals. Finally, a new group of methods, based on cultured human cells, will also be reviewed.
ORAL PRESENTATIONS
Session 1 (PART 1)

EPIDEMIOLOGY

Chairmen:
Dominique CHOUDAT, Cochin Hospital, Occupational Pathology, Paris
Guy HEDELIN, INRS, Vandoeuvre-les-Nancy
Emergence of occupational allergies and current trends in Europe

Paris C.

Occupational Pathology Consultation Centre, Faculty of Medicine, Vandœuvre-lès-Nancy, France

With several hundred allergens identified for occupational asthma and allergic contact dermatitis, the surveillance and diagnosis of these disorders require continuous monitoring by both allergists and occupational physicians. New sensitizers are regularly identified, sometimes in epidemic form as in the case of dimethyl fumarate. The diagnosis of protein contact dermatitis has also developed, as well as, in general, that of immediate cutaneous reactions which, in a large number of cases are related to occupational exposure. Then there are also the immediate cutaneous reactions to drugs, which may concern health professionals preparing drugs under certain conditions. With regard to delayed reactions, recommendations have been made over the past few years to include in the European baseline series new substances such as fragrances used in cosmetics. As for respiratory disorders, new allergens are regularly reported; Pralong et al. [1] have tallied 41 new low-molecular-weight allergens associated with occupational asthma between 2000 and 2010.

Another facet in the emergence of occupational allergies in Europe has been the change in the prevalence of these allergic manifestations over time, leading either to a diminution or an increase in the allergens in question, whether or not the sensitising property of those allergens has been identified. An example is the significant reduction in occupational asthma due to latex in the health sector, while at the same time, cases due to quaternary ammonium have increased [2]. Within this framework, the implementation of sentinel surveillance networks, as in the United Kingdom (SWORD, EPIDERM) and in France (ONAP, RNV3P) is important for disseminating alerts, but also for the surveillance of time trends in occupational allergy cases [3]. The goal of this conference is therefore to present the new allergens described in the literature over the past few years, and to describe the main evolutions over time of allergens associated with these pathologies and their current characteristics. This knowledge is essential for implementing a suitable and adaptive prevention approach.

Respiratory effects of an exposure to grain dust among grain workers in the Vaud region (Switzerland)

Doribo V.1, Pralong JA.1, Wild P.2,3, Reboux G.4, Oppliger A.5, Danuser B.1, Niculita-Hirzel H.5*, Krief P.1*

1 Service of Occupational Medicine, Institute for Work and Health, Lausanne, Switzerland
2 Institute for Work and Health, Lausanne, Switzerland
3 Institut National de Recherche et de Sécurité, Nancy, France
4 Service of Parasitology and Mycology, CHU de Besançon, Besançon, France
5 Service of Occupational Hygiene, Institute for Work and Health, Lausanne, Switzerland
* These authors contributed equally to this work

Keywords: Grain dust, respiratory effects

Introduction: Bioaerosols such as grain dust (GD) contain biologically active agents (e.g. endotoxins, peptidoglycan, mycotoxins, bacteria, fungal spores & hyphae) that may induce local inflammation, direct immunological reactions, or have cytotoxic effect within the human respiratory system. Hence, exposure to GD may lead to adverse health effects including asthma, chronic bronchitis, chronic obstructive disease, hypersensitivity pneumonitis, and organic dust toxic syndrome. Despite this observation, few data are available about the correlation between intensity, duration and nature of the exposure to GD and the induction of these pathologies in grain workers. Exposure intensity depends on the time spent by each operator in direct contact with GD, and varies from one workplace to another; grain handling and GD cleaning are the most exposing activities. Moreover, weather, but also harvesting, handling and storing conditions greatly influence the nature of the exposure by modifying GD flora and thus its biologically active fractions.

Aim: To assess the clinical impact of occupational exposure to GD by comparing exposed and non-exposed workers during both high and low GD-exposure seasons. To determine quantitative biological markers of bioaerosol exposure.

Methods: This longitudinal study has begun in summer 2012, and is expected to end in summer 2013. Four groups of grain workers exposed to different levels of GD will be compared to two control groups of urban workers living in either urban or rural area. Each group comprises 30 volunteers. After obtaining informed consent, occupational history and a detailed medical history including respiratory, skin and ocular symptoms, and concomitant exposures are questionnaire-assessed. Lung function is evaluated by spirometry. Eosinophilic airway inflammation is assessed by measuring exhaled nitric oxide (eNO). Immunologic host response is sought by ELISA titration of blood immunoglobulins. These parameters will be collected 6 months apart (at high- and low-exposing seasons).

Results: The preliminary results presented hereafter are those of two of the four exposed groups, namely harvesters and mill workers, compared to the control groups, at first assessment. The exposed and unexposed groups are similar in mean age (38.4 years) and gender (98% male). Grain workers have significantly (p<0.05) more daily contact with animals (57%) and active smoking (39%) than controls (40%, 11% respectively). Prevalence of respiratory (50%), nasal (57%), ocular (45%), dermatologic (36%) and systemic (20%) occupational symptoms in grain workers are significantly higher than in controls (6.4%, 19%, 16%, 6.4%, 1.6% respectively, p<0.05). Significantly lower mean peak-expiratory-flow (PEF) value is seen in the exposed groups (96.1±18.9 vs. 108.2±17.4 [% of predicted], p<0.05). Lower eNO values are observed in the exposed groups (13.9±9.6 vs. 20.5±14.7 [ppm], p<0.05).

Conclusion: Preliminary results show a higher prevalence of clinical symptoms and a lower mean PEF value in the exposed groups, as compared to the control groups. A supplementary analysis will take place, taking into account the exposed groups not yet included, and the confounding factors, detailed personal exposition data and biological markers of exposition.
Baker’s asthma: inflammatory markers of occupational exposure to flour dust

Marraccini P. 1, Cantone L. 2, Marsili C. 3, Leghissa P. 4, Mosconi G. 4, Barretta F. 3, Patrini L. 5, Previdi M. 1

1 Unità di Allergologia Ambientale ed Occupazionale, Fondazione IRCCS Cà Granda Ospedale Maggiore Policlinico Milano Via San Barnaba 8, 20122 Milano, Italia
2 Dipartimento di Scienze Cliniche e di Comunità Università degli Studi di Milano Via San Barnaba 8, 20122 Milano, Italia
3 Dottorato in Medicina del Lavoro, Università degli Studi di Milano Via San Barnaba 8, 20122 Milano, Italia
4 Unità Operativa di Medicina del Lavoro. Azienda Ospedaliera Ospedali Riuniti di Bergamo Largo Barozzi 1, 24128 Bergamo, Italia
5 Unità Operativa di Medicina del Lavoro, Fondazione IRCCS Cà Granda Ospedale Maggiore Policlinico Milano Via San Barnaba 8, 20122 Milano, Italia

Keywords: Occupational exposure to allergens, baker’s asthma, in vitro tests, cytokines,

Introduction: Baker’s asthma is still one of the most relevant occupational asthma that involves about 5-10% of bakers. It is worth notion that flour dust is pro-inflammatory and can determine both non-allergic airway inflammation and enhancement of allergen-mediated airway. Moreover, exposure to flour can play a role in the development of rhinitis and asthma in occupationally exposed workers. Aim of the study was the clinical evaluation of exposed workers in relation to some inflammatory markers.

Methods: Three groups of subjects, altogether 104 male and 1 female bakery workers (mean age 41 yrs), were so distributed: 31 healthy subjects, 31 atopic (cutaneous positivity at least one environmental allergen) and 43 occupational asthma ones. The groups were homogeneous and had a mean exposure to flour dust about 20 years; 37% were smokers. Clinical assessment was performed in all the subjects and included skin prick tests and specific IgE (environmental allergens and occupational ones such as wheat, rye, oat grain, barley grain and α-amylase), spirometry, methacholine challenge and specific bronchial challenge were also included, if needed. Among the atopic workers 9 subjects suffered from rhinitis and 4 workers from seasonal asthma. Evaluation of fractional expired nitric oxide (FeNO) (NIOXMINO Aerocrine AB Sweeden) and serum cytokines, such as IL6, IL8 and TNF-α, were performed (ELISA test R&D Systems – USA).

Results: IL6 mean values ± SD were 16.8 ± 19.9 pg/ml in healthy workers, 15.7 ±7.2 pg/ml in atopic workers and 4.7 ±7.3 pg/ml in subjects with professional respiratory symptoms. IL8 resulted respectively 65 ± 149.8, 88.4 ± 149.8 and 43.9 ± 21.8 pg/ml in the same three groups. IL6 and IL8 were significantly increased in healthy and atopic subjects compared to workers with occupational asthma (p < 0.001 for IL6 and p < 0.02 for IL8). According to linear multivariate analysis serum IL6 was related to drug therapy (p< 0.05). A slight increase of TNF-α was also observed in all the analysed groups without statistically significant differences. FeNO (> 35 ppb) was significantly increased in 75% of subjects suffering from occupational asthma and in 46% of atopic workers, but only 8% of healthy subjects showed an increased value (p < 0.007). In addition, a statistically significant correlation was observed between the values of IL8 and FeNO (p < 0.05).

Conclusions: In workers exposed to flour dust the increase of cytokines is probably related to an inflammatory stimulus that involves both the immune response Th1 and Th2. Such cytokines might be assumed as a defensive response either in atopic or healthy workers, suggesting their use as markers of exposure. On the contrary, subjects with occupational asthma showed a slight increase of cytokines, probably related to the steroids daily assumed. Moreover, FeNO can be used as a monitoring parameter of inflammation, and it seems to be related to IL8, which is responsible for neutrophil recruitment into the lung.
Asthma among workers in healthcare settings: role of disinfection with quaternary ammonium compounds

Gonzalez M.1, Jégu J.2,3, Kopferschmitt M.Ch.4, Donnay C.1, Hédelin G.2,5, Matzinger F.4, Velten M.2,3,6, Guilloux G.7, Cantineau A.1, de Blay F.4

1 Occupational Diseases Department, University Hospitals, Strasbourg, France
2 Department of Epidemiology and Public Health, EA 3430, Faculty of Medicine, University of Strasbourg, France
3 Department of Public Health, University Hospital of Strasbourg, France
4 Division of Asthma and Allergy, Chest Diseases Department, University Hospitals, Strasbourg, France
5 Department of occupational epidemiology, French National Research and Safety Institute, Vandoeuvre-lès-Nancy, France
6 Department of Epidemiology and Biostatistics, Paul Strauss Comprehensive Cancer Center, Strasbourg, France
7 Immuno-Allergy Division, Institut Merieux, Lyon, France

Keywords: Work-related asthma, healthcare workers, nurses, cleaners, quaternary ammonium compounds, occupational exposure, disinfection

Introduction: An increased incidence of asthma has been reported among healthcare workers. How this is linked to quaternary ammonium compounds (QACs), commonly used in cleaning/disinfection products, has not yet been clearly defined. The aim of this study was to analyze the link between asthma and occupational exposure to disinfectants, especially QACs.

Methods: The study population was a stratified random sample of the various healthcare departments from 7 healthcare settings. The study included: questionnaire, physical examination, spirometry and specific IgE assays. Occupational exposure was assessed using a work questionnaire, workplace studies and a review of product composition. Data were analyzed by logistic regression.

Results: 543 workers (89% female) responded to our survey, the response rate was 77%. 37.1% were registered nurses (RNs), 16.4% auxiliary nurses (ANs), 17.3% cleaners; 32.8% had atopy. 335 participants were exposed to QACs as part of their work. A significantly higher rate of physician-diagnosed asthma was reported for nursing professionals, and nasal symptoms at work were more prevalent for RNs than for administrative staff working in the healthcare sector. The symptoms were particularly associated with disinfection tasks and exposure to QACs. Exposure to QACs significantly increased the risk of physician-diagnosed asthma and nasal symptoms at work (adjusted OR = 7.5 and 3.2 respectively). Other potential sources of allergens - such as latex in gloves, chlorinated products / bleach or glutaraldehyde - were examined, but no significant association was found.

Conclusion: RNs and ANs presented a higher risk of reported asthma than administrative staff. The highest risk was associated with tasks involving dilution of disinfection products, which are known to be strong respiratory irritants. Manual dilution of these products could lead to repeated exposure to concentration peaks. Workplace interventions will now be necessary to more clearly determine QAC exposure and improve disinfection procedures.
Session 1 (Part 2)

EPIDEMIOLOGY

Chairmen:
Christophe PARIS, CHU, Vandoeuvre-les-Nancy
Guy HEDELIN, INRS, Vandoeuvre-les-Nancy
Is the incidence of aliphatic amine-induced occupational rhinitis and asthma underestimated?

Laborde-Castérot H. 1,2, Rosenberg N. 1, Dupont P. 1, Garnier R. 1,3

1 AP-HP, Saint-Louis Lariboisière Fernand-Widal University Hospital, Occupational and Environmental Pathology Consultation Centre, 200 rue du Faubourg Saint-Denis, 75010 Paris, France
2 Paris Descartes University, Paris Sorbonne City, Occupational Health Division, Paris, France
3 Paris Diderot University, Sorbonne Paris City, Occupational Health Division, Paris, France

**Keywords:** Occupational rhinitis, occupational asthma, diagnosis, specific challenge

**Background & aims:** Patients with occupational rhinitis (OR) or asthma (OA) usually report a history of multiple occupational exposures that need to be investigated, this makes their etiologic diagnosis challenging. In addition, diagnostic methods such as skin tests or laboratory tests are often not readily available for low molecular weight compounds. Thus, a specific provocation test is often the only way to confirm the etiological hypothesis. As comprehensive investigation of cases is time-consuming and may be laborious, it is not always performed. In France, this does not constitute an obstacle to gaining compensation for an occupational disease, as the presumption of an occupational origin is sufficient. This approach, while good for patients, poses an epidemiological problem in that the causal agent is generally selected arbitrarily, often with a preference for highly publicised compounds.

Amines, some of which are known to cause asthma, are frequently present in the work environment, but are rarely identified as responsible for compensated OA. Amine-induced OA may therefore be under-reported. To discuss this hypothesis, we report on a cohort of patients with a positive reaction to an amine-specific nasal provocation test (NPT) in our occupational health unit.

**Methods:** Review of the medical records of 36 patients with OR (alone or associated with asthma) tested by NPT with an aliphatic or alicyclic amine present in a product used at work. A positive test result was indicated by doubling of nasal resistance, as measured by posterior rhinomanometry.

**Results:** Seven patients presented OR alone and 29 patients presented OR associated with asthma-like symptoms. Most patients worked in the healthcare sector (paramedics, n=14) or for a cleaning company (industrial or domestic cleaning, n=10). Occupational sources of amines were mostly cleaning products (detergents, disinfectants, scouring agents, grease removers, etc. n=28).

The six patients with a positive NPT worked as: cleaner, chambermaid, nurse, nurse’s aide, childcare assistant, dental assistant, plastic molder. Positive NPTs were identified for the following amines: bis(aminopropyl)laurylamine (3 positive tests out of 8), 4-dimethylpropylamine (1/1), 2,2’-dimethyl-4,4’-methylene-bis-cyclohexylamine (1/1), N-lauryl-N,N-dimethylamine oxide (1/2). Four patients were also exposed to quaternary ammonium compounds at work, specific NPT with these compounds was negative.

NPTs were also negative for the following amines: monoethanolamine (0/16), diethanolamine (0/3), triethanolamine (0/7), isopropanolamine (0/1), triethylamine (0/1), triethylenetetramine (0/1), aminopropyltriethoxysilane (0/1), alkylpropylenediamineguanidine acetate (0/1).

**Discussion:** This case series is the first report of respiratory disease caused by certain amines, documented by a specific challenge. The frequency of amine-induced OR/OA may therefore be underestimated, particularly when cleaning products are incriminated. These results suggest that etiologic data derived from epidemiological studies, occupational disease monitoring programs or occupational disease compensation records should be interpreted with caution. Physicians should be encouraged to investigate these cases more thoroughly.
Characterising work-related dermatosis resulting from contact allergy to proteins

Barbaud A.1, Paris C.2, Waton J.1

1 Service de dermatologie, Unité de dermato-allergologie ADERME, Centre hospitalo-universitaire de Nancy, Hôpitaux Brabois, Université de Lorraine, 54500 Vandoeuvre les Nancy, France

2 Centre de consultations de pathologie professionnelle, Centre hospitalo-universitaire de Nancy, Hôpitaux Brabois, Université de Lorraine, 54500 Vandoeuvre les Nancy, France

Keywords: Chronic hand eczema, protein contact dermatitis, allergic contact urticaria, neutrophilic fixed food eruption, prick test

Work-related contact dermatitis is most often linked to haptens, but it can also be due to proteins inducing allergic contact urticaria (ACU); chronic hand eczema has also been reported with protein contact dermatitis (PCD).

Objective: To determine the characteristics and frequency of protein-related contact allergy.

Method: Mono-centre, retrospective study (2006 to 2012), using data from a computerized dermato-allergology database. Patients with hand or forearm dermatosis and positive tests to proteins were included.

Results: Of 5882 referred patients, 25 cases (0.4%) were included (7 males, 18 females, mean age: 31.2 yrs). Among these, there were: 19 cases of PCD, 5 ACU and 1 neutrophilic fixed food eruption (NFFE). Of the PCD cases, 16 were work-related; 11 were food handlers - of whom 4 had become sensitized to fish, the others were sensitized to seafood, latex, milk, onion, chestnut and apples, egg or cucumber, respectively - other cases were due to amniotic liquid in a veterinary surgeon, hair conditioners, flower profilins and latex in 2 healthcare workers. PCD was confirmed by positive prick tests (15 cases) or open test (1 case); patch tests performed with the same products returned negative results. Nine (56%) of patients with PCD were atopic with positive prick tests to airborne allergens. Among 5 work-related ACU, prick tests were positive to latex (3 cases), hair conditioner or guinea-pig. A case of NFFE was observed in a cook handling fish. Until this diagnosis was made, recurrent bullous plaques on forearms had been considered as a factitious dermatosis for 6 years. Patch tests and prick tests performed on the residual scars with fish and shrimp had immediate and delayed positive results.

Conclusion: Few series of well-characterized cases with contact sensitization to proteins have been reported. This study reports the first case of work-related NFFE. Contact sensitization to proteins is frequently work-related, inducing a range of difficult to diagnose dermatoses. These require prick tests, and not patch tests, to identify the causative allergen.
Session 2

METROLOGY

Chairmen:
Philippe DUQUENNE, INRS, Vandoeuvre, France
Wijnand EDUARD, NIOH, Oslo, Norvège
Health risks and occupational exposure to microbial allergens, a complex relationship

Eduard W.

National Institute of Occupational Health, PO Box 8149 Dep., NO-0033 Oslo, Norvège

Keywords: Fungi, allergens, endotoxin, exposure-response

Microorganisms are ubiquitous and can be found airborne in all environments. They contain antigenic and allergenic compounds (proteins, polysaccharides) and may contain metabolites (enzymes, toxins). As microorganisms produce metabolites when metabolically active, these agents can also be present in particles originating from colonialized substrates.

Humans should be well adapted to cope with exposure to these organisms that developed eons before us. However, microorganisms may cause respiratory disease inhaled in high concentrations. Fungi and actinomycetes have been studied in working and general populations as causes of allergic respiratory diseases including allergic alveolitis/hypersensitivity pneumonitis, asthma and rhinitis. The association with asthma is not simple as asthma is generally less prevalent in populations highly exposed to microorganisms than in general populations, although positive exposure-response associations have been found in highly exposed populations. Furthermore, atopy and other genetic variants of immunity significantly modify exposure-response associations.

The strongly pro-inflammatory endotoxins originating from Gram-negative bacteria are generally present in microbial aerosols. These toxins are not allergic as they induce non-specific inflammation but seem to modify the response to allergens in a complex manner. Exposure to high endotoxin levels exacerbate symptoms in allergic individuals, whereas the incidence of atopic diseases is lower in endotoxin exposed populations. It is thought that the induction of non-specific inflammation by endotoxin exposure may inhibit the development of allergic inflammation (the hygiene hypothesis).

The microbial species is important when assessing exposure to microbial allergens. Specific microorganisms can be measured by cultivation methods, but these methods suffer from poor precision and sensitivity problems because dead and degraded microorganisms are not detected although their allergens may still be active. Molecular biological methods can detect specific microorganisms independent from cultivability. In outdoor air studies microscopic methods are commonly used, in spite of limited potential for identification.

Risk assessment of microbial allergens is further complicated by lack of regulatory occupational exposure limits (OEL) for microorganisms. Health based criteria are available for fungal spores (lowest observed effect level of 100,000 spores/m³ for non-pathogenic and non-toxin producing species), and for endotoxins (proposed OEL of 90 EU/m³ in the Netherlands). Both criteria are based on non-specific inflammatory effects, however.

Recent studies demonstrated anaerobic bacteria that are difficult to cultivate to be present in high concentrations in the farm environment using molecular biological methods; biodiversity was inversely related to asthma, the allergenic potential of hyphal fragments from fungi to be higher than of spores, and the liberation of large numbers of sub-micronic particles from fungal cultures.

Thus, better measurement methods for allergenic microorganisms are needed as well as epidemiological studies in order to gain a better understanding of exposure-response relationships of microbial allergens and its interactions with other bioaerosol agents. An update of this field will be given at the conference.
Monitoring exposure to soya aeroallergens during dockside unloading

Mason H. 1, Olles-Gomez S. 2, Cruz M.J. 2, Smith I. 1, Evans G. 1, Simpson A. 1, Baldwin P. 1, Smith G. 3

1 Health and Safety Laboratory, Buxton, SK17 9JN, UK
2 Servicio de Neumología, Hospital Universitario Vall d’Hebron, Barcelona, 08035, Spain
3 Health and Safety Executive, Alnwick House, Benton Park View, Newcastle, NE98 1YX, UK

Keywords: Soya beans, soya hull, aeroallergens, docks

Soya has become one of the most important agro-products worldwide, being a widely used source of protein, oil and biofuel substrate. The UK imported some 3.3 million tonnes of soya in 2010, largely from Brazil. Soya oil only accounted for about 0.11 million tonnes; while 2/3 of the remainder were imported as soya meal and husks, and 1/3 as soya beans. Other major uses of soya products, such as flour and oil, are in the food and bakery industries. Soya products are imported at a number of UK ports equipped to handle bulk grain, agrochemicals and foodstuffs.

While constituents of soya are one of the top eight causes of food allergy, proteins within the soybean and its husk are also occupational and environmental allergens by inhalation. Outbreaks of epidemic asthma have been reported in a number of harbour cities such as St Nazaire, New Orleans, Naples, Cartagena, Tarragona, Coruña, Valencia and Barcelona due to soya dust inhalation. Exposure to soya dust and soya flour has been reported to cause occupational asthma (OA) in persons working in a variety of occupations, such as farmers, mill workers, soybean handlers and bakers.

Allergens causing OA in bakers due to soya flour inhalation seem to differ from those related to asthma outbreaks in dock communities. Immunochemical investigation demonstrated that in the latter situation asthma is specifically due to an acidic low molecular mass glycoprotein located principally in the hulls and dust of soybeans unloaded in the harbour, identified as two isoallergens, Gly m 1a and Gly m 1b, with molecular weights of 7.0 and 7.5 KDa, respectively. These isoallergens were highly homologous with a protein described as the hydrophobic soybean protein (HSP). Individual allergic response to inhaled soybean flour components differs considerably between bakers, but involves several higher molecular weight allergens, including Kunitz soybean trypsin inhibitor (STI) of 21 KDa molecular weight.

An occupational hygiene investigation of soya handling at two UK docks has been carried out by the Health and Safety Executive (HSE). Some 51 personal air samples and 41 static air samples, including both task-based and environmental samples, were taken, as well as samples of the bulk material being handled. Specific soya allergenic proteins (STI and HSP), soluble total protein (STP) and gravimetric dust analysis were measured in the collected samples. This paper discusses the value of specific allergen versus non-specific measurements in assessing the control of exposure during unloading of this high usage agro-product with allergenic properties.
Monitoring exposure to microbial enzymes used to clean endoscopes

Smith I. 1, Anua, SM. 3, Mason H. 1, Stagg S. 1, Griffin P. 2, Dick F. 3, Semple S. 3, Evans G. 1

1 Health and Safety Laboratory, Buxton, SK17 9JN, UK
2 Health and Safety Executive, Redgrave Court, Bootle, L20 7HS, UK
3 Environmental and Occupational Medicine, University of Aberdeen, AB25 2ZD

Keywords: Endoscopy, cleaning, enzymes, exposure

Increasing use is being made of microbial enzymes as cleaning agents. Decontamination and sterilisation of endoscopes is critical to control risks from infections. Glutaraldehyde was traditionally used to disinfect endoscopes but its use has been discontinued because it can cause occupational asthma. New endoscope cleaning solutions are being used which contain combinations of microbial enzymes to remove proteins, mucins, and fats. These cleaning solutions are marketed as natural and environmentally friendly products, but contain enzymes from organisms such as Bacillus subtilis and Aspergillus oryzae which are known respiratory allergens and may cause dermatitis. In GB one workplace exposure limit (WEL) has been set for the bacterial enzyme subtilisin (40ng/m3 8 Hr TWA). Several cases of asthma attributed to enzyme cleaning solutions have been reported amongst health sector staff cleaning endoscopes.

Exposure assessment visits were undertaken at seven endoscopy cleaning units at three different hospitals. Information about the enzyme cleaning products and processes used was collected along with evidence about risk assessments and control measures applied. Personal samples were collected from those involved in endoscope cleaning and static samples close to the cleaning work. Wipe samples were taken from different locations in the endoscope cleaning rooms. Proteolytic activity in each sample was quantified using fluorescent quenched assay and expressed in relation to a purified subtilisin protease standard. Bulk samples of the cleaning solutions also were analysed for their proteolytic activity. Six different enzyme cleaning solutions were used by these hospitals and a recently developed specific immunoassay for subtilisin Calsberg was used to assess whether these products contained the enzyme for which a WEL applies.

Staff using these products were generally unaware that they contained enzyme allergens and the material safety data sheets provided little information to inform good control practice for work with sensitising agents. Variations in techniques used to manually pre-clean endoscopes were noted between units with some taking more precautions including use of personal protective equipment. Only 4 out of 14 personal air samples contained detectable (8.9, 14.5, 17.4 and 66.7 ng/m3) subtilisin equivalent activity and 6 out of 14 static air samples (0.6, 7.0, 9.3, 10.2, 14.4 and 45.1 ng/m3). Very high concentrations of enzyme (up to 267µg/100cm2) were measured on wipe samples surrounding the sinks where manual pre-cleaning work was undertaken. High levels (up to 1 µg/100cm2) were found at other sites around these rooms. Levels of enzyme solution around automated washing machines were in comparison very low. By specific immunoassay four out of the six cleaning products were shown to contain subtilisin Calsberg.

Contact exposure to enzyme cleaning solutions amongst healthcare workers was considered more likely when undertaking pre-cleaning of endoscopes and the risk of inhalation exposure cannot be ruled out unless good control practice is applied. More needs to be done to educate users about safe use of these products and suppliers could provide more information in safety data sheets to help achieve this.
It is reported that more than 15% of the workers in crab and shrimp processing plants develop asthma and allergic reactions once they come in contact with crustacean flesh and cooking water. During crustacean processing, aerosols and vapors are released into the air at the different workstations, leading to occupational exposure through the respiratory tract. More than 15 workstations have been identified as being hazardous, which include butchering, sorting, cooking, cleaning, packing and wrapping, to name only a few. In the province of Québec, close to 34 plants process crab and shrimp. These plants employ around 2000 workers per year for crustacean processing tasks for a period of 8 to 10 weeks during the spring.

Studies have identified tropomyosin and arginine kinase as being the major allergen proteins found in crab and shrimp. These allergen proteins induce a type 1 IgE dependent hypersensitivity in exposed workers. These proteins have a high molecular weight, are water soluble, thermostable in the case of the tropomyosin, and knowledge allows the analytical development of well-advanced specific methods targeting these allergens. Liquid chromatography coupled with tandem mass spectrometry is the analytical approach of choice for specifically evaluating the presence of tropomyosin and arginine kinase from snow crab and northern shrimp. The methods involve digestion of the harvested proteins, followed by the analysis of the peptides characteristic of each protein. The amount of peptide detected is then converted into the amount of protein originally present in the sample.

Such analytical methods allow improvement of the knowledge about crustacean-related asthma. Now, the need to map the workplaces where allergen proteins are present is essential in order to suitably protect the workers’ health. Appropriate protection can be achieved by good workplace mapping. In parallel, characterization of the aerosols produced is needed in order to use a sampling system suitable for the crustacean problem. Efficient collection of the allergen proteins is an essential step in achieving good mapping.

Two parallel activities were conducted. First, a sampling activity with Teflon filters was initiated in 9 plants located in the province of Québec in order to evaluate the extent of the presence of tropomyosin and arginine kinase in snow crab and northern shrimp plants. As well, one plant was targeted where particle size distribution measurements of the aerosols were done at several workstations in order to eventually select the appropriate sampling device. The results obtained show that tropomyosin and arginine kinase were present at all the workstations investigated. The concentrations found were between 0.002µg/m$^3$ and 2.2µg/m$^3$. With these results, a relocation of sensitized workers seems challenging because allergens were detected everywhere. Also, investigation of the aerosol size distribution identified the particle size distribution profile at different workstations, with mass median aerodynamic diameters ranging between 1.1µm and 7µm.
Occupational exposure to airborne allergenic fungi in green coffee factories

Niculita-Hirzel H., Charrière N., Oppliger A.

Service of Occupational Hygiene, Institute for Work and Health, Lausanne, Switzerland

Keywords: Green coffee dust, airborne fungi, bioaerosols, biological risks

Introduction: Green coffee bean (GCB) is a well-known allergen capable of causing allergic respiratory symptoms in workers exposed. Respiratory symptoms have been linked even to relatively low levels of GCB, fact that justify further investigation on the constituents of the GCB from coffee factories such as bacteria, fungi, allergens and endotoxins. In particular, fungi pose potential health risks because of their production of allergens, a wide range of mycotoxins, and inflammatory substances such as beta-D-glucan. Several studies have demonstrated the relationship between increased spore counts and fungal antigen levels with the presence of allergic symptoms. Nevertheless fungal communities associated with green coffee and/or airborne green coffee dust are poorly known and deserves some attention. Indeed, coffee is cultivated in very different geographical regions and specific fungal communities are supposed to be very rich due to climatic factors and very variable in regard to their origin.

Aim: Characterization of airborne fungal community at different workplaces from coffee processing plants with identification of the dominant and the most frequent species.

Methods: Quantification of airborne cultivable fungi by impaction on specific nutrient agar. Identification of the species using PCR methods (113 samples collected in two different plants during different tasks and in two different seasons).

Results: Airborne levels of fungi associated with certain tasks have been found to be very high (> 100’000 CFU/m3) and largely exceed the Swiss recommendations. Molecular identification has shown that the three most frequent and more dominant airborne fungi were defined as sources of allergens, inducers of IgE-mediated sensitization, and causes of atopic respiratory diseases like allergic rhinitis or asthma. Indeed, Aspergillus section nigri, Penicillium crustosum and Cladosporium oxysporum were found in very high concentrations during all the different occupational tasks.

Conclusion: Workers in green coffee processing plants can be exposed to very high concentrations of airborne allergenic fungi. Therefore, it will be important to explore the relation between the level of exposure to these airborne fungi and the IgE-mediated sensitization to moulds in exposed workers. Thus, these tools might help the occupational or general practitioner physician to regularly monitor the evolution of allergic symptoms in the green coffee workers in order to prevent deleterious impairments and general health deterioration.
High resolution microscopic characterization of submicronic fragments generated from
*Apergillus fumigatus* cultures

Afanou A.K.J. ¹, Halstensen A.S. ¹, Skogstad A. ¹, Tronsmo A. ², Hjeljord L. ², Green B.J. ³, Eduard W. ¹

¹ National Institute of Occupational Health, Oslo, Norway
² University of Life Science, Ås, Norway
³ Centers for Disease Control and Prevention, HELD NIOSH, Morgantown, USA

**Keywords:** Submicronic fragments, characterization, high resolution scanning electron microscopy

**Introduction:** The aerosolization of submicronic fungal particles containing antigens and possibly allergens and mycotoxins has been suggested to play a role in the adverse health effects related to mouldy buildings. This suggestion is based on studies reporting the generation of submicronic particles under laboratory conditions. In these experiments particles were liberated by blowing air jets on fungal cultures grown on semi-solid nutrient plates or gypsum plates, and particles were quantified by direct reading particle counters. However, the presence of such particles in indoor environments has yet to be demonstrated. This study aims to assess the occurrence and the nature of particles that are aerosolized when fungal cultures are subjected to air currents.

**Methods:** Two week-old cultures of *Aspergillus fumigatus* grown on malt extract agar (MEA) and MEA covered with cellophane were aerosolized during one minute at 12 and 20 L/min in two particle generators: a Fungal spores Source Strength Tester (FSSST) and a novel Particle Generator (Stami PG). Particles were collected onto polycarbonate filters and qualitatively and quantitatively analyzed using field emission scanning electron microscopy (FE-SEM). Surface structures such as rodlets at high resolution (magnification 50,000 – 200,000 X) were used for identification of the submicronic fragments originating from fungal spores.

**Results:** The total number of aerosolized particles from MEA was 2x10⁶ and 3x10⁷ particles/cm² of culture plate when SPG was used at 12 L/min and 20 L/min, respectively. With the FSSST these values were approximately lower by a factor of 10 at both flow rates. From MEA covered with cellophane, similar concentrations were obtained. The aerosol composition was dependent on generator, air flow and media. With SPG and MEA, the proportions of the submicronic fragments were approximately 27% and 1% at 12 and 20 L/min, respectively, and with the FSSST these values were 76% and 12%, respectively. With MEA covered with cellophane, the submicronic fragment proportions were significantly reduced: 9% and 0.2% with SPG at 12 and 20 L/min, respectively; 12% and 5% with FSSST. About 13% of the submicronic fragments showed rodlet structures with samples collected from MEA.

**Discussion:** This study confirms that submicronic fungal fragments were indeed generated from cultures of *A. fumigatus* and these particles could partly be recognised and quantified at high microscopic resolution. Part of submicronic fragments resulted from spore fragmentation. The proportion of the submicronic fraction depended on media, generator and air flow. Results on *A. versicolor* and *P. chrysogenum* will be presented at the conference.
Setting indicative guidance values for exposure to laboratory animal allergens?

Mason H., Smith I., Evans G.

Health and Safety Laboratory, Buxton, SK17 9JN, UK

Keywords: Laboratory animal allergens, aeroallergen measurement, rat n1, mus m1.

Exposure to laboratory animal allergens (LAA) particularly from mice and rats remains a significant cause of sensitisation, followed by respiratory and ocular symptoms. The severity of symptoms in those sensitised and with further low-level exposure can be variable, but may be serious enough to preclude continuing in employment where laboratory animals are involved. Exposure can occur in the Pharma industry, contract toxicology laboratories, medical research facilities and also breeding facilities.

Immunochemical methods to measure LAA have become increasingly refined and standardised. The mouse mus m1 and rat n1 major allergens can be measured with good sensitivity and specificity, using well-characterised standards and antibodies. However, evidence for setting safe, health-based exposure guidelines for both sensitised and non-sensitised workers is weak or non-existent. Both anecdotal data and that from surveillance schemes suggest that sensitisation and symptoms are still being encountered. Therefore, interpretation of LAA monitoring data in terms of adequacy of control needs to be pragmatically based on what is currently being achieved, rather than any exposure level associated without any significant risk to health.

HSL has undertaken LAA analyses since 2005, directly for Pharma companies as well as independent occupational hygienists monitoring across sectors such as biotech and universities where laboratory animals may be employed. The majority of the monitoring is of air samples, while some surface wipe testing has also been employed. The major rodent allergens, mus m1 and rat n1, have been measured using Indoor Biotechnology reagents on a TECAN robotic ELISA platform.

As part of the establishment of these analyses, we investigated a number of pre-analytical factors that may influence the results. These factors included stability of the particulate allergens collected on filters, the efficiency of allergen extraction from various filter types, the stability of eluted allergens prior to analysis and long-term analytical precision. Method implementation was based around gaining analytical adequate sensitivity (1-5 ng.m⁻³) when monitoring short-term exposures of 10-15 minutes using standardised sampling rates of 2 L.min⁻¹.

As part efforts to add interpretative data we have reviewed on two previous occasions our cumulative LAA data, where results can be expressed in ng.m⁻³, to produce a distribution of anonymised results with the 90th percentile defined. These two initial reviews have shown highly skewed distributions for both mus m1 and rat n1 allergens with relatively stable upper 90th percentiles around 16 and 4 ng.m⁻³ respectively. Our suggestion has been that the 90th percentile may be a useful indicative guidance value, with atmospheric monitoring results over this level triggering urgent review of exposure control, against a general policy of reducing all exposures to as low as practical.

We are undertaking a more formal review of all our LAA monitoring data from 2005 to October 2012. This involves a database of over 1,000 mus m1 and 700 rat n1 results.
Session 3

TOXICOLOGY AND BIOMETROLOGY (Part 1)

Chairmen:
Harri ALENIUS, FIOH, Helsinki, Finlande
Jean-François NICOLAS, Lyon 1 University, France
Immunology of allergic contact dermatitis

Vocanson M. 1, Rozières A.1, Nosbaum A.1, Bensaid B.1, Mutez V., Lenieff V., Poyet G., Rodet K., Delattre C., Bérard F.1, Nicolas J.F.1

1. Lyon 1 University, UFR Lyon Sud, IFR128, University Hospital Network of Lyon, INSERM U851, 21 Avenue Tony Garnier, 69365 Lyon Cedex 07, France

Allergic contact dermatitis (ACD), one of the commonest occupational diseases, is a T-cell-mediated skin inflammation caused by repeated skin exposure to contact allergens, i.e. nonprotein chemicals called haptens. ACD involves both skin resident cells and activated skin infiltrating T cells. Activation of skin resident cells plays an essential role in the sensitization phase though the activation of pattern recognition receptors such as TLR, inflammasome activation and production of reactive oxygen species all of which contribute to the release of IL-1 family members and chemokines. Chemokines then regulate the migration of skin dendritic cells and the presentation of the contact allergen in the draining lymph node as well as the recruitment of these activated, allergen reactive CD4+ and CD8+ cells back into the skin. This inappropriate innate skin immune response occurs in susceptible individuals and results in the sensitization process.

The skin inflammation of ACD is mediated by CD8+ T cells, which are primed in lymphoid organs during the sensitization phase and are recruited in the skin upon re-exposure to the hapten. Subsets of CD4+ T cells endowed with suppressive activity are responsible for both the downregulation of eczema in allergic patients and the prevention of priming to haptens in nonallergic individuals. Therefore, ACD should be considered as a breakdown of the skin immune tolerance to haptens.

Recent advances in the immunology of ACD (1) have demonstrated the important role of skin innate immunity in the sensitization process and have revisited the dogma that Langerhans cells are mandatory for CD8+ T cell priming. They have also introduced mast cells as a pivotal actor in the magnitude of the inflammatory reaction. Finally, the most recent studies address the nature, the mode and the site of action of the regulatory T cells that control the skin inflammation with the aim of developing new strategies of tolerance induction in allergic patients.

Regulatory support for respiratory and skin sensitizers

Rousseau C.\textsuperscript{1}, de Lentdecker C.\textsuperscript{2}, Bastos H.\textsuperscript{1}, Fastier A.\textsuperscript{2}

\textsuperscript{1} Anses, Regulated Products Directorate, REACH-CLP Unit
253, avenue du Général Leclerc, 94700 Maisons-Alfort, cedex

\textsuperscript{2} Anses, Regulated Products Directorate, Toxicology of Regulated Products Unit
253, avenue du Général Leclerc, 94700 Maisons-Alfort, cedex

Keywords: Sensitizers, REACH, biocides, plant protection products

The current regulations do not include a test to assess respiratory sensitization. Generally, respiratory sensitization is detected in human studies and, in the absence of other supportive data, it is difficult to class substances causing this effect.

Until recently, respiratory and cutaneous sensitizers were not a priority in the context of REACH regulations (CE 1907/2006) as most interest was focused on CMR (Carcinogenic, Mutagenic, Reprotoxic), PBT (Persistent, Bioaccumulative, Toxic) and vPvB (very Persistent, very Bioaccumulative) substances. However, the latest adaptation to the CLP regulations ((EC) No 1272/2008) added sub-categorization 1A or 1B for sensitizers. This categorization induced us to take a closer look at article 57f of REACH with a view to identifying the sensitizers of greatest concern which should potentially require authorization before their use.

The regulations require skin sensitization tests for all active substances or products (REACH regulation, dir CE 98/8 and dir CE 91/414 and regulation CE 1107/2009 and CE 528/2012). In these texts, the endpoint is assessed according to the following consecutive steps:
1. an assessment of the available human, animal and alternative data
2. in vivo testing by a Murine Local Lymph Node Assay (LLNA) including, where appropriate, the reduced variant of the assay. If another skin sensitization test is used, its use must be justified.

The product/mixture does not need to be tested if:
- valid data are available for each of the components in the mixture to allow it to be classed according to the rules laid down in Directive 1999/45/EC and Regulation (EC) No. 1272/2008 (CLP), and if no synergistic effects between components are expected,
- the available information indicates that the product should be labelled as skin sensitizing or corrosive,
- the substance is a strong acid (pH < 2.0) or base (pH > 11.5),
- the substance is flammable at room temperature.

The main issues with this type of substance, in this regulatory context, are as follows:
- it is difficult to identify respiratory sensizers due to the lack of suitable animal tests,
- the effects observed may be difficult to correlate with exposure to a substance because reactions may be immediate or delayed
- most tests cannot be used for quantitative risk assessment, as most regulatory measures are based on hazards rather than risks.

Some case studies will be presented to illustrate the above discussion, when possible including the method proposed by Anses to quantitatively assess the risk of skin sensitization.
Occupational contact allergy to compounds contained in epoxy resin systems is frequently observed. Especially in the construction industry, an increasing number of workers has been sensitized to epoxy resin during the last 18 years. Various efforts have been made in order to reduce the risk of contact allergy, e.g. change of packaging and application devices to minimise exposure. However, a priority approach to reduce risk of obtaining contact allergies would be the substitution of strong skin sensitising compounds by substances with lesser sensitising potency, if technically feasible. Thus, a research project aimed at developing a ranking method regarding the sensitising potency of epoxy resin components was funded by the German Social Accident Insurance (DGUV).

In this project, a semi-quantitative assessment of 51 sensitising compounds commonly used in epoxy resin systems was performed using a weight of evidence approach. Based on the current mechanistic understanding of contact allergy, minimal data requirements were defined to classify the sensitisation potency, assigning each substance to one of the three following categories. They ranged from “very high sensitising potency” (SHS) and “high sensitising potency” (HS) to “low or moderate sensitising potency” (GMS). Due to the lack of sufficient test results from in vivo experimental data (e.g., LLNA studies), special focus of the project was put on data from in vitro experiments and in silico calculations. The classification system was designed to be applied without further animal testing and to provide a generalisable categorisation tool for skin sensitising substances.

For substance assessment all available data from in vitro and in silico, as well as results obtained from animal studies or human testing were used to evaluate the sensitising potency of each substance. Observations on humans were collected and interpreted by experts from the IVDK. After all data were brought together, data gaps leading to the default categorisation “HS” were identified and documented, thus facilitating future assessment after conducting further in vitro assays, if appropriate.

Up to now, approximately 50% of the substances could be assigned to a specific sensitising potency category (~28% HS; ~20% GMS), whereas for the remaining substances only default assumptions could be made based on insufficient data. The assignment of all 51 investigated substances is to be made available by means of a publicly accessible platform in order to facilitate substance selection in epoxy resin product formulations. This platform shall provide a comprehensive overview, systematic assessment and ranking of sensitising epoxy resin components.

Within this presentation, the approach used for categorising substances according to their sensitising potency is outlined and results from in vitro testing, initiated during the run of this project, are presented. Furthermore the overall results of the research project are summarised.

1 Abbreviations taken from German translation of sensitising potency categories
The role of the transcriptional factor Nrf2 in contact hypersensitivity

El Ali Z. 1, Gerbeix C. 2, Esser P. 3, Robert P. 4, Legrand J.J. 2, Martin S. 3, Pallardy M. 1, Kerdine-Römer S. 1

1 Paris Sud University - INSERM UMR-996, Pharmacy Faculty, 5 rue J.B.Clément, 92296 Châtenay-Malabry, France
2 CIT-Safety and Health Research Laboratories, BP 563, F-27005 Evreux, France
3 Allergy Research Group, Dermatology Department, University Medical Center Freiburg, D-79104 Freiburg, Germany
4 Paris Sud University – Animal facility and functional exploration platform - ou IPSIT, Pharmacy Faculty, 5 rue J.B. Clément, 92296 Châtenay-Malabry, France

Keywords: Nrf2, contact hypersensitivity, dendritic cells, contact sensitizers, MEST, LLNA

Allergic contact dermatitis (ACD) is one of the most common skin diseases, affecting 15–20% of the general population worldwide. It is classified as a delayed-type hypersensitivity response, and murine contact hypersensitivity (CHS) is one of the most frequently used animal models of ACD. Most of the chemicals that induce CHS are small compounds called haptens, which typically have a molecular mass of 500 d. When these small compounds interact with proteins they can elicit an adaptive immune response. Thus, ACD is characterized by two phases: a sensitization phase and an elicitation phase. During sensitization, skin dendritic cells (DCs) capture the hapten bound to an autologous protein, migrate through the lymphatic vessels, and present the hapten-protein complex to naive T cells in the draining lymph node.

Chemical sensitizers, which cause CHS in mice, are also known to induce production of reactive oxygen species (ROS). The Nrf2/Keap1 pathway is central for detoxification. Nrf2 is a redox-sensitive basic leucine zipper transcription factor involved in the transcriptional regulation of many antioxidant genes. Nrf2 plays a central role in protecting cells from ROS and electrophiles. We have demonstrated that, in vitro, contact sensitizers induce Nrf2 accumulation in human DC.

To determine the role played by Nrf2 in CHS, we used the Local Lymph Node Assay (LLNA) to study the sensitization phase, and the Mouse Ear Swelling Test (MEST) to investigate the elicitation phase. These studies were performed in nrf2 knock out (nrf2−/−) and in wild type (nrf2+/+) mice; dinitrochlorobenzene (DNCB) was used as the test compound.

MEST results showed that (DNCB) (1%) induced a larger increase in ear thickness in nrf2−/− mice than in nrf2+/+ mice. Furthermore, the swelling increase was time-dependent after challenge. Sensitization of mice with DNBC (0.5%) induced a highly significant response in nrf2−/− mice compared to nrf2+/+ mice, where no swelling was observed after challenge. On the other hand, results obtained in LLNA showed that DNBC induced an increase of lymphocyte proliferation in nrf2−/− and nrf2+/+ mice. However, the stimulation index (SI) for the same DNBC concentration was higher in nrf2−/− mice than in nrf2+/+ mice.

These results underline the crucial role played by Nrf2 in CHS. Nrf2 seems to control the inflammatory response and lymphocyte proliferation, both of which are involved in the allergic response to chemical sensitizers.
Session 3

TOXICOLOGY AND BIOMETROLOGY (Part 2)

Chairmen:
Marc PALLARDY, INSERM U461, Châtenay-Malabry, FR
Alain SIMONNARD, INRS, Vandœuvre-les-Nancy, FR
Identifying allergens in manufactured products

Langlois E. 1, Crepy M.N. 2, Guillemot M. 1, Mélin S. 1, Ravera C. 1, Bensefa-Colas L. 2, Descatha A. 3, Ameille J. 3, Choudat D. 2

1 French National research and safety institute (INRS). Rue du Morvan. CS 60027. 54519 Vandœuvre-Lès-Nancy Cedex, France
2 Cochin Hospital, Occupational and environmental diseases department, AP-HP, 27 rue Faubourg Saint-Jacques, 75014 Paris, France
3 Occupational diseases, occupational health and insertion department, Raymond Poincaré Hospital, 104, boulevard Raymond Poincaré, 92380 Garches, France

Allergies to chemical substances due to repeated or prolonged contact are increasing as plastic materials are becoming more widely used. Patch tests are available to test for positive reactions to some of these substances, but they are not universal. In addition, a positive reaction in a patch test does not identify the specific compound causing the allergy.

It is possible to determine and confirm the link between the substance and the allergy through chemical analysis of the manufactured material in contact with the skin. This type of diagnosis is essential for allergy treatment, but also to find a substitution solution. This is necessary as occupational allergy is often related to protective equipment (clothing, glasses or gloves), and it is important to find alternative equipment free of the relevant allergen, but providing the same degree of protection.

Three case studies are presented here to illustrate how chemical analysis can help identify the allergen; we also discuss the limits of the technique. A method is proposed to routinely screen for known allergens in protective gloves used in medical care.

The first case involves allergic contact dermatitis leading to leucoderma, caused by contact with a spectacle frame. Scrapings from the spectacle frames and several chemical compounds, including p-tert-butylphenol (PTBP), induced positive patch test reactions. Chemical analysis of the varnish on the spectacle frame confirmed the presence of PTBP. This is the first reported case of allergic contact dermatitis leading to leucoderma induced by wearing spectacles due to sensitization and exposure to phenolic compounds contained in the varnish.

The second case presented with dermatitis of the foot related to wearing protective footwear. Patch tests revealed a positive reaction to several chemical compounds. Different parts of the shoes were extracted with solvent and exposed to fibers for solid-phase micro extraction (SPME). These fractions were then analyzed. Several hundred organic substances were identified, but none matched the substance identified through the patch test. In this case, chemical analysis was not sufficient to conclude on the source of the dermatitis.

The last case was contact allergy caused by repeated contact with PVC gloves. Patch tests revealed positive reactions to pieces of glove, thiuram mix, stearyl alcohol and tricresyl phosphate. High performance liquid chromatography (HPLC) of a solvent-extracted glove fragment confirmed the presence of tricresyl phosphate. However, the glove supplier denied that this compound was present in the glove composition.

These cases reveal the challenges of using chemical analysis to identify allergens in manufactured products: information about target chemical substances is required to direct the analyst toward the confirmation of its presence in the material. Consequently, based on the third case presented, we propose an analytical protocol to routinely screen for most current allergens in PVC gloves.
Exhaled breath condensate is a suitable matrix to assess airway dose and effects of occupational exposure to beryllium and beryllium compounds

Hulo S. ¹,²,³, Grzebyk M. ⁴, Radauceanu A. ⁴, Edmé J.L. ¹,²,³, Dziurla M. ⁴, Bertrand C. ⁴, Veillé M. ⁴, Honnert B. ⁴, Dorotte M. ⁴, Sobaszek A. ¹,²,³, Hédelin G. ⁴

¹ Lille Nord of France University, F-59000 Lille, France  
² UDSL, EA 4483, F-59000 Lille, France  
³ CHU Lille, F-59000 Lille, France  
⁴ French Research and Safety Institute for the Prevention of Occupational Accidents and Diseases, Rue du Morvan. CS 60027, 54519 Vandoeuvre-lès-Nancy Cedex, France

**Keywords:** Effect biomarkers, beryllium, lung disease, exhaled breath condensate

**Background:** Exposure to beryllium (Be) has been shown to lead to beryllium sensitization (BeS) and chronic beryllium disease (CBD), a long latency granulomatous disorder primarily affecting the lungs. Despite an increased understanding of the pathogenesis of BeS and CBD, little is currently known about the relationships between external exposure, internal exposure and early respiratory effects. The deposition and clearance of inhaled Be particles are governed by dose, chemical form, solubility, particle size, cumulative exposure, duration of exposure etc. Research is ongoing to develop non-invasive techniques in occupational environments to provide information on exposure levels and local effects at target organ level. One promising approach is analysis of exhaled breath condensate (EBC). In this study, we evaluated whether EBC is suitable to assess airway dose and effects in workers exposed to various forms of Be in the workplace.

**Methods:** A total of 120 exposed and unexposed workers were recruited between 2009 and 2011. The exposed group comprised 82 subjects (age 43.8 ± 8.9 years, 84% men) from machining, electrical assembly and aluminum production plants. The unexposed group consisted of 38 subjects (age 44.4 ± 10.7 years, 58% men) with no significant history of lung disease and not occupationally exposed to Be. Prior to collecting individual data, each plant was inspected to confirm exposure to different chemical forms of Be and the main exposure routes - respiratory [soluble form (BeF), relatively soluble forms (Al-Be 62%, Cu-Be 2-3% alloys)] and through skin contact (Cu-Be 2% alloy) - as well as work station and task descriptions. Individual data were collected at the workplace through responses to a standardized questionnaire related to subject’s past and current medical history, tobacco use, work history and task description. Spirometry and fractional exhaled nitric oxide (FeNO) were also measured; a blood sample was taken to investigate selected polymorphisms, and a urine sample was used to measure Be levels; EBC was collected using a portable device (ECOSCREEN Turbo) to investigate the levels of Be and of some inflammatory and oxidative stress biomarkers (proteins, nitrogen oxides, 8-isoprostane, 3-nitrotyrosine, TNF-α) in exhaled breath.

**Results:** Compared to unexposed workers, workers exposed to relatively soluble forms of Be exhaled higher levels of proteins (7.38±21.69 vs 6.19±21.05 µg/ml), those exposed through skin contact exhaled higher levels of nitrogen oxides (17.23±10.60 vs 8.26±3.69 µM), and workers exposed to soluble forms of Be had increased Be levels (1.17±1.22 vs 0.602±0.35 ng/l) in EBC.

**Conclusions:** The present study demonstrates that Be and biomarkers of inflammation and oxidative stress can be measured in the EBC of workers exposed to different forms of Be in their workplace. Exhaled elements may reflect the lung dose responsible for local toxic effects and can provide insights into the oxidative interactions between pulmonary tissue and pneumotoxic metals. Analysis (semi)quantitative assessment, biomonitoring, EBC) is ongoing to determine the relationship between different exposure parameters and early respiratory effects (exhaled biomarkers, lung function parameters).
Session 4

PREVENTION

Chairmen:
Jean-Raymond FONTAINE, INRS, Vandoeuvre, FR
John SAUNDERS, HSL, Buxton, UK
The use of local exhaust ventilation for controlling airborne allergens in the workplace and a comparison of industry approaches

Saunders C.J.

Health and Safety Laboratory
Harpur Hill, Buxton, SK17 9JN,
United Kingdom

Extraction at source, often referred to as local exhaust ventilation (LEV), is probably the most widely used engineering control for reducing worker exposure to airborne contaminants. However, it is frequently the least well understood type of engineering control and subsequently suffers from misuse and is often miss-sold. It is important that the design of the LEV system, and in particular the hood, is matched to the potential for overexposure. This therefore means that the LEV design needs to take into account the toxicity of the contaminant and the energy and direction with which it is released. For a number of reasons, which will be addressed during the presentation, effective, and importantly reliable control can be variable.

This presentation will review a range of LEV systems designed to control allergens, will include case studies from a range of industry sectors and will be supported by recent research into LEV effectiveness. In addition a variety of different contaminant sources will be considered, from highly energetic directional sources through to contaminant sources that are small in size and released with little energy.

Specific examples will include paint spraying of vehicles with isocyanate based paint. Isocyanates are a potent asthmagen and spray painting should be carried out in an enclosed ventilated booth. Whilst spray booth designs vary, all have high ventilation rates. Nevertheless, paint sprayers are still at risk from occupational asthma. The reasons as to how and why paint sprayers are exposed will be discussed along with suggested solutions. A further example will include hand soldering, which produces colophony fume, again an asthmagen. Effective control of solder fume would appear to be straightforward; however statistics show that many workers still contract occupational asthma from exposure to solder fume. The range of LEV controls available for this work activity will be explored along with recent research as to why some LEV designs are not as effective as anticipated. This case study will be supported with an example from industry where a relatively simple LEV modification resulted in a significant reduction in workplace exposure levels to colophony fume.

The presentation will consider other LEV examples from industry and in doing so will conclude by examining how different industry sectors approach LEV and the reasons why some sectors are more successful than others with regard to LEV solutions.
Developing a method to assess emission levels from machines used in bakeries

Bonthoux F.

French National research and safety institute (INRS), Rue du Morvan. CS 60027, 54519 Vandœuvre-Lès-Nancy Cedex, France

Keywords: Emission rate, methodology, flour, bakery

Nearly 100,000 bakers in France are directly exposed to flour dust emitted by machines used in bakeries. To limit cases of occupational asthma, the development and use of low-pollution machines is being encouraged. For this to be effective, a method to evaluate and compare different equipment options must be developed.

We first attempted to assess emissions based on existing standards (EN 1093 series), which aim to determine absolute emission rates. Uncertainties - related in particular to the instruments used to measure dust concentration, to the variability of particle-size in flours, and to the air management conditions of the test room - lead to a wide dispersion of results, with the uncertainty related to some components exceeding 50% of the final result. In addition, the set-up required to use the standardized methods (in particular the test cabin for Standard EN 1093-3) is beyond the price-range of most equipment manufacturers, who wish to improve their equipment using an iterative modification / evaluation process.

To overcome these difficulties, we developed a system where emission is expressed as a fraction of the emission from a reference source substituted for the machine being assessed. The advantage of relative emission level measurement is that it makes it unnecessary to identify and control numerous parameters. This also allowed us to use a simplified test cabin: measurements can be performed in a temporary, low-cost facility such as a commercially available temporary welding tent (that can be dismantled) equipped with an extractor fan.

With a method based on a reference source, almost all of the constraints are shifted towards the design of that source: it should be easy to generate, reproducible and repeatable. In this case, the source was based on a controlled sieving operation. This reproduces emission, and equalises the parameters related to the nature of the flour; thus, machine qualification becomes independent of the flour used.

To finalise the proposed method, the prototype reference source developed must be simplified and made more reliable.
What factors influence the dustiness and exposure to allergens in bakery improver mixtures?

Fraser S., Mason H., Thorpe A., Roberts P., Smith I., Morton J., Mark D., Evans G.

Health and Safety Laboratory
Harpur Hill, Buxton, Derbyshire, SK17 9JN, UK

Keywords: Bakeries, wheat flour allergen, soya trypsin inhibitor, aeroallergens

The incident rate of occupational asthma in the UK remains highest amongst bakery workers. Allergens in flour and microbial enzymes are the primary causes of respiratory allergy in this group. Some of the highest allergen exposures occur amongst those staff involved in making dough improvers, since this requires handling and dispensing concentrated stocks of microbial enzymes along with other ingredient in improvers. In addition to flour allergens, bakery improvers contain microbial allergens such as fungal alpha amylase, hemicellulase and soya trypsin inhibitor from soya flour. Other ingredients include vegetable oil, calcium sulfate and emulsifiers (usually a mixture of organic fatty acid esters and calcium silicate). This study investigated whether exposure to these allergens could be reduced at source by altering the ‘dustiness’ of dough improvers. This required an understanding of what factors influence the dustiness of improver mixtures in order to identify ways of reformulating these mixtures to reduce exposure.

An EU standardised ‘dustiness’ test (EN15051) was applied and the gravimetric mass of different fractions of the dust determined (i.e., inhalable, thoracic and respirable). The allergen content of these dust fractions was measured using immunoassays for soya allergen (soya bean trypsin inhibitor- STI) and wheat flour antigen (WFA). The concentrations of specific ingredients of dough improver (calcium silicate, calcium sulfate and vegetable oil) were manipulated in a standard improver mix supplied by the manufacturer and provided to HSL in colour coded sets. The dustiness of the most effective improver mixtures was evaluated by hand mixing ingredients in an user test chamber.

Increasing the vegetable oil content of the improver was the most effective method of decreasing dustiness of improver and exposure to allergens. An increase in the oil content from 2% to 4% led to a 77% decrease in airborne concentrations of WFA and STI. The overall dustiness was increased by ingredients such as calcium sulfate and to a lesser extent calcium silicate, which is added in smaller amounts as a free flow agent. On its own flour was not as dusty as other ingredients but when mixed with these the dustiness of the flour and enzyme allergens increased considerably.

The ingredients of improvers contribute to the overall dustiness of flour and enzyme allergens and therefore potential exposure to bakers. Reformulation of improvers can reduce dustiness as long as these adjustments are within acceptability criteria for the quality of the dough and final bread product. For example, a combination of increasing the oil content and decreasing the calcium salt would help to reduce the dustiness at source and as control method is suited to small bakeries that may struggle to finance expensive engineering control solutions.

We acknowledge the partnership with the Association of Bakery Ingredient Manufacturers (ABIM) in carrying out this project and funding by the Health and Safety Executive (HSE).
From the emerging risk to reducing occupational exposure
Case of nitrogen trichloride in swimming pools

Gérardin, F., Héry M.

French National research and safety institute for the prevention of occupational accidents and diseases (INRS), Rue du Morvan, CS 60027, 54519 Vandœuvre-Lès-Nancy Cedex, France

In swimming pools, chlorine is widely used for disinfection; this chlorine reacts with nitrogen-containing elements (urea, ammonia, amino acids, etc.), provided continuously by swimmers. As the nitrogen-containing molecules are degraded by chlorine, haloforms, aldehydes and chloramines are produced. The most halogenated chloramine, nitrogen trichloride (trichloramine, NCl3), is very volatile and has been linked to ocular and respiratory irritation in lifeguards and other swimming pool workers.

Because of this irritation, both swimming pool workers and hygienists are very concerned about occupational exposure to NCl3. A method to sample and analyze gaseous nitrogen trichloride has been developed and used to perform toxicological and epidemiological studies. From these data, a threshold limit value of 0.5 mg/m³ was proposed. However, when attendance levels are high in pools, this limit value is frequently exceeded in the atmosphere. Until recently, all swimming pool attendants could do to limit NCl3 exposure was to verify that swimmers respected certain rules of hygiene. Substitution of chlorine by another bactericidal compound has, to date, not been successful. To overcome this, research was undertaken into efficient and safe technological solutions to reduce exposure. This led to companies proposing UV technology to treat chloramines in water in the last 10 years. However, these have not entirely responded to the problem as these devices may in fact form toxic by-products. This has become a major concern for health authorities in different countries.

Other techniques have been applied, such as adding a gas/liquid extraction, or stripping, step to the recycling loop during water treatment. The trichloramine extracted by this process can be treated by photocatalysis before rejecting it into the atmosphere, thus limiting its environmental impact. This technology is very efficient and reduces nitrogen trichloride exposure to acceptable levels. This work was performed with the aim of designing clean and safe processes, it was further expanded to develop a predictive model of nitrogen trichloride formation and its behavior in pools. This model is based on the study of both physical and chemical phenomena in water and air, taking pool characteristics and attendance into account.

All the work undertaken by INRS on this subject contributed to recognizing pathologies due to NCl3 exposure as occupational diseases by the general social security regime. The recognition of these occupational diseases has been expanded to food industry workers, including those preparing ready-to-use fresh vegetables, and those cleaning and disinfecting production facilities.
How reducing exposure impacts allergic diseases: comparison of national preventive approaches in the UK and France

Bensefa-Colas L. ¹, Stocks S.J. ², Telle-Lamberton M. ³, Faye S. ³, Luc A. ⁴, Lasfargues G. ³, Paris C. ⁴, Agius R. ² and RNV3P and THOR research team members

¹ Occupational Diseases Service, Cochin University Hospital, APHP, Paris Descartes University, Sorbonne Paris Cité, 27 rue du Faubourg Saint Jacques, 75014 Paris, France
² Centre for occupational and environmental health, Health Science Group, School of Community-Based Medicine, Faculty of Medical and Human Sciences, The University of Manchester, United Kingdom
³ French Agency for food, Environmental and Occupational Health and Safety, 27/31 Avenue du Général Leclerc, 94701 MAISONS ALFORT Cedex, France
⁴ Occupational Diseases Department, University Hospital, INSERMU954 – Nutrition, Genetics and Exposure to Environment Hazards, Faculty of Medicine, 9 rue de la Forêt de Haye 54500 Vandoeuvre-Lès-Nancy, France

Keywords: Occupational asthma, allergic dermatitis, latex, chromate, cement, prevention, network

Objective: Several national programs have been set up to reduce exposure to allergens in the workplace in recent years in the UK and France. However, the effectiveness of these measures has not been assessed at a national level. We present data comparing trends in occupational disease monitoring in France and the UK for allergic contact dermatitis attributed to chromate in cement, and asthma attributed to latex. The data are considered within the context of changes in legislation in these two countries.

Methods: For analysis pertaining to allergic dermatitis attributed to chromate in cement, the time period was selected to coincide with the introduction of European Union legislation (2003). This legislation was implemented in 2005 in both the UK and France. For latex, the time period coincided with a change in French compensation legislation in 2003, and a change in UK regulatory legislation in 2004. Data were provided by two nationwide reporting networks for occupational diseases: THOR in the UK, and RNV3P in France. The temporal trends for contact dermatitis (CD) relative to cement use and for asthma related to latex gloves were analyzed in these data over the 2002-2008 period. Methods were adapted to the context of each country (different network design and different preventive measures).

Results: Contact dermatitis attributed to chromate in cement and asthma attributed to latex declined significantly in both countries over the period analyzed. In the UK, for the 2002 to 2008 period, the annual change in incidence for allergic CD attributed to chromate versus the annual change in incidence for all other causal agents was 0.91 (95% confidence interval; 0.84-0.98); for asthma attributed to latex it was 0.73 (0.58-0.92). In France, data on CD attributed to contact with cement showed a two-period pattern: before 2005 and after 2005 (lower occurrence of notification); the 2003 change in latex-related compensation legislation resulted in an increase of asthma notification (possibly motivated by a hope of compensation), followed by a decrease in subsequent years due to more extensive use of powder-free gloves with reduced protein content.

Conclusion: Allergic contact dermatitis induced by chromate, and occupational asthma due to latex decreased significantly when steps were taken to reduce exposure. A similar trend was observed in two distinct networks, in the UK and France, indicating that European preventive actions are highly effective in these two countries.
POSTERS
Iron oxide particles modulate the ovalbumin-induced Th2 immune response in mice.

Ban M., Langonné I., Huguet N., Guichard Y., Goutet M.

French Research and Safety Institute for the Prevention of Occupational Accidents and Diseases (INRS), Rue du Morvan, CS 60027, 54519 Vandœuvre-Les-Nancy Cedex, France

Keywords: Submicron and nano sized iron particles, OVA-induced Th2 response, immunosuppressed, immunoenhanced

In workplaces, exposure to particulate pollutants can lead to numerous respiratory pathologies. However, the role of the pulmonary immune response in these pathologies has not yet been resolved. This study was designed to investigate how submicron and nanosized iron oxide (Fe₂O₃) particles modulate the ovalbumin (OVA)-induced Th2 immune response in BALB/c mice.

Particles were administered intratracheally to mice four times before and during the OVA sensitization period. Three different particle doses were used for each particle type, 4 X 100, 4 X 250 or 4 X 500 µg/mouse. Four groups of mice were constituted for each dose: saline solution, OVA, particles, and OVA plus particles.

Mice exposed to OVA alone exhibited a Th2-dominated allergic response with a consistent increase in inflammatory scores, eosinophil numbers, specific IgE levels and IL-4 production. When the mice were exposed to OVA and to high and intermediate doses of iron oxide submicron- or nanoparticles, eosinophil influx and specific IgE levels were decreased, indicating inhibition of the OVA-induced allergic response. At the low dose (4 X 100µg), submicron particles did not significantly affect the OVA-induced allergic response, while nanoparticles had an adjuvant effect on the Th2 response to OVA.

These data demonstrate that the pulmonary immune response to OVA is sensitive to intratracheally instilled particles. The allergic response was suppressed or enhanced by different particle doses and sizes.
Submicron and nanomicron iron-oxide particles affect pulmonary immunity in mice

Ban M., Langonné I., Huguet N., Goutet M.

French Research and Safety Institute for the Prevention of Occupational Accidents and Diseases (INRS), Rue du Morvan, CS 60027, 54519 Vandœuvre-Les-Nancy Cedex, France

Keywords: Submicron and nano-iron oxide particles, lung-associated lymph nodes, innate immunity

In workplaces, exposure to particulate pollutants can lead to numerous respiratory pathologies. However, the role of the pulmonary immune response in these pathologies has not yet been resolved. The aim of this study was to identify potential local immunotoxic, adjuvant and inflammatory effects in mice exposed via the respiratory pathway to silica microparticles and iron oxide micro- and nanoparticles.

The inflammatory and immunotoxic effects of silica and iron-oxide particles was examined in BALB/c mice who had previously received one or four intratracheal instillations of each type of particle at three different doses. The effects of the particles on local responses (pro-inflammatory cytokine production, inflammatory cell influx, humoral immune response and natural killer cell activity) were examined.

Significant increases in the number of inflammatory lung cells (macrophage and neutrophil) were observed with all three types of particle. A reduced immune response to sheep red blood cells was also noted with all particle types, while no effect was observed on the innate immune response. Pro-inflammatory cytokine production by lymph node cells increased only with iron oxide particles (both nano and micro). At equivalent iron oxide doses, the immunosuppressive and inflammatory effects of nanoparticles were greater than for microparticles.

These results show that micro and nano iron oxide particles clearly have an immunosuppressive effect on the local humoral immune response to a particulate antigen. We have used them to better define the effects of particles on the immunological mechanisms potentially linked to respiratory pathologies like infection, allergy and cancer.
The occupational dermatology atlas: an image-based prevention tool

Crépy M.N. 1, Tennstedt D. 2, Cleenewerck M.B. 4, Zerbib D. 5, Descatha A. 1, Bensefa-Colas L. 2, Choudat D. 2, Ameille J. 1

1 Occupational diseases, occupational health and insertion department, Raymond Poincaré Hospital, 104, boulevard Raymond Poincaré, 92380 Garches, France

2 Occupational and environmental diseases department, Cochin Broca Hôtel-Dieu hospitals group, AP-HP, Paris Descartes University, Sorbonne Paris Cité higher education and research alliance, 27 rue Faubourg Saint-Jacques, 75014 Paris, France

3 Dermatology department, Saint-Luc University Hospital, Avenue Hippocrate, 10 1200 Brussels, Belgium

4 Occupational health service, Occupational health cluster, 118 rue Solférino, 59015 Lille, France

5 French-language Virtual Medical University, Paris Descartes, France

Keywords: Occupational dermatology, eczema, contact dermatitis, contact urticaria, occupational exposure, hazards, prevention, educational document, guide, interactive document, iconography

Introduction: Occupational dermatoses are one of the leading occupational illnesses in many countries. Eczema, mainly on the hands, is the most frequently declared form of dermatosis in industrialised countries. These diseases may have major socio-professional consequences and their prevention is hindered by the diversity of their clinical presentations and causes, by technological issues, and due to insufficient knowledge of the risks run by occupationally exposed subjects. Information is a key element in any preventive strategy. Dermatology, whether occupational or otherwise, requires specific information based on images. Many interactive documents are available for use in general dermatology, but not specifically for occupational dermatology.

Objectives: This interactive photo-based occupational dermatology atlas should help to improve prevention in the workplace. It should facilitate the rapid recognition of diseases by physicians when consulted by patients, and will help make diagnostic procedures more uniform and reliable in the French national network for the monitoring and prevention of occupational diseases (RNV3P). The atlas aims to provide occupational physicians, dermatologists, allergy specialists and general practitioners with support for:
- Diagnosis of dermatosis based on analysis of elementary skin lesions and presentation of the most common occupational dermatoses;
- Differential diagnosis through comparison with images of non-occupational dermatoses;
- Aetiological diagnosis and determining causality, through illustrations of observed cases, as a function of job description and the major associated risks (mainly irritants and allergens).

Through information on causes, aggravating factors and means of prevention, the atlas could also be used to develop treatment education programmes for chronic diseases, such as eczema, and to help patients improve how they deal with their own dermatoses. It could also constitute a tool for raising the alarm in cases of new clinical presentations of occupational dermatoses or emerging allergens.

Methods and results: The photographs were taken with a digital camera and mainly show patients with suspected occupational dermatoses referred to the occupational disease centres of Cochin Hospital (Paris) and Raymond Poincaré Hospital (Garches), the Dermatology Department of Saint-Luc University Clinic (Brussels) and the occupational health unit of the Occupational Health Centre (Lille). The atlas includes a mixture of photographs of the most frequent dermatoses, linked to the substances most frequently causing them, and illustrations of rarer, or even unusual, cases observed during occupational dermatology consultations.
This interactive, educational document is available via the Internet, from the INRS website, at the following address: [http://www.atlasdermatologieprofessionnelle.com/index.php/Accueil](http://www.atlasdermatologieprofessionnelle.com/index.php/Accueil). It provides the user with access to over 500 photographs, via various key words relating to diagnosis, profession, risk, site and clinical signs. The illustrations in the atlas represent the most frequently encountered clinical aspects of the main occupational dermatoses observed (e.g., contact dermatitis, urticaria and mycosis). Rarer cases that should not be misdiagnosed, and other dermatoses that may be aggravated by occupational exposure (atopic dermatitis) or could constitute differential diagnoses (dyshidrosis, nummular dermatitis, palmar psoriasis) are also presented. The images can also be accessed in relation to job descriptions and related risks, which are mainly irritants and allergens. This atlas is limited to occupational dermatoses. Occupational dermatoses mainly affect the hands and forearms, they affect the face, neck, trunk and legs more rarely. Elementary lesions should be analysed to establish a dermatological diagnosis.

**Conclusion:** This atlas has been in development since 2006 and is constantly evolving due to continual changes in the occupational dermatoses observed as a consequence of industrial development, the use of new materials, chemicals and more aggressive cleaning products, stricter hygiene and disinfection rules and progress in medical research.
Allergenic airborne *Penicillium* species: a DNA sequence-based and bioinformatic study

Davolos D. ¹, Pietrangeli B. ¹

¹ INAIL, Dept. of Production Plants and Human Settlements, Via Urbana 167, 00184 Rome, Italy
E-mail address: d.davolos@inail.it

Keywords: Bioaerosol, *Penicillium* aeroallergen, alkaline serine proteases, IgE epitopes

A thorough knowledge of airborne microfungal diversity can shed light on the role the microfungi play in respiratory problems, such as the rapidly increasing prevalence of allergies. However, despite its importance for both allergic conditions and public health in general, the information currently available on the indoor filamentous fungi and yeasts is limited. Recently, we have studied *Penicillium* species (Ascomycota) found in indoor environment (e.g. air, dust layers) because rarely these filamentous ascomycetes have been adequately characterized and identified. In our ongoing study, we apply a phylogenetic approach, based on the multilocus sequence data, for the molecular characterization and identification of taxa belonging to the genus *Penicillium*. *Penicillium simile* ATCC MYA-4591 is a novel species, isolated from the bioaerosol in a workplace, we described using an approach whose phylogenetic analysis is based on nuclear ribosomal RNA and protein coding genes (Davolos et al. 2012). Moreover, in *P. simile* and in other indoor *Penicillium* species, including *Penicillium raistrickii*, we have analyzed important genes with special emphasis on those encoding alkaline serine proteases secreted extracellularly, which were identified as major aeroallergens in a few *Penicillium* species examined to date. Phylogenetic trees and reasonable three-dimensional structural models of the deduced serine proteases were constructed. Interestingly, modelling the structures of the novel alkaline serine proteases of *P. simile* and *P. raistrickii*, it has been possible to show that octapeptides corresponding to known *Penicillium* IgE epitopes are exposed on the protein surface, as expected for IgE binding sites. Lastly, innovative culture-independent approaches, including next generation sequencing technologies, are being used to characterize the non-cultivable microfungal portion of bioaerosol from indoor environments. This information will help to formulate a background at the molecular level addressing the dynamics of *Penicillium* species and other relevant microfungi found indoors.

References
Respiratory health and working conditions in composting facilities

Demange V. ¹, Duquenne P. ², Simon X. ², Coulais C. ², Dziurla M. ¹, Grzebyk M. ¹

¹ French Research and Safety Institute for the Prevention of Occupational Accidents and Diseases (INRS), Occupational Epidemiology Division, Rue du Morvan, CS 60027 54519 Vandœuvre-lès-Nancy Cedex, France

² French Research and Safety Institute for the Prevention of Occupational Accidents and Diseases (INRS), Pollutants Metrology Division, Rue du Morvan, CS 60027 54519 Vandœuvre-lès-Nancy Cedex, France

Keywords: Occupational epidemiology, longitudinal study, respiratory health, composting facilities

Rationale: occupational exposure in composting activities seems to generate acute, non-specific disorders. Few studies have addressed the potential medium-term consequences on workers health. Little is known about the allergenic and inflammatory risks related to bioaerosols produced by composting activities.

Objectives: to determine the effect of factors such as materials being composted, indoor or outdoor conditions, on-site processes involved, and season on workers’ respiratory health, in particular chronic airway inflammation.

Methods: composting facilities were included based on their technical characteristics. All male volunteer workers were followed up over two years with a consultation every six months (four consultations in all). At each consultation, spirometry was performed and exhaled nitric oxide was measured. Workers answered two questionnaires, one relating to respiratory health and the other relating to work tasks and collective and personal protective equipment. At the first consultation, training and occupational history was recorded, and prick tests with common allergens were also performed.

Results: as data collection is still in progress, only data from the first two consultations will be presented. Ninety one subjects working in 35 facilities were included. Twenty eight subjects (31%) worked in 15 sewage sludge composting facilities, the remaining 53 (69%) worked in 20 green-waste composting facilities. Mean age was 39 years (standard deviation = 9 years). Thirty six subjects (40%) had at least one positive reaction to common allergens. There was a higher proportion of positive reactions among workers from green-waste facilities than from sewage sludge facilities (48% versus 21%, p=0.02). The overall average of observed FEV1/predicted FEV1 ratio was 99% for both groups. The median exhaled nitric oxide measured was 11 ppb (minimum=2 ppb, maximum=70 ppb) for all 75 subjects tested for this parameter. In subjects with one or more positive skin reactions to prick tests, exhaled nitric oxide was measured at 12 ppb (minimum=3, maximum=70); while subjects with no positive skin reaction had a median of 11 ppb (minimum=2, maximum=48). Eighty seven subjects have had their second visit 6 months later.

Discussion and perspectives: this study will provide information about the possible association between working conditions in composting facilities and the presence or degree of chronic inflammation of the airways.
Factors affecting concentrations of thermophilic microorganisms and endotoxins in composting facilities

Duquenne P. 1, Demange V. 2, Simon X. 1, Coulais C. 1, Dziurla M. 2, Grzebyk M. 2

1 French National research and safety institute (INRS), Pollutants Metrology division, Rue du Morvan, CS 60027, 54519 Vandœuvre-lès-Nancy Cedex, France

2 French National research and safety institute (INRS), Occupational Epidemiology division, Rue du Morvan, CS 60027, 54519 Vandœuvre-lès-Nancy Cedex, France

Keywords: Occupational exposure, airborne aerosol, thermophilic microorganisms, endotoxins

Objectives: To determine for composting facilities which factors affect concentrations of thermophilic microorganisms (sensitizers) and endotoxins (inflammatory triggers), such as the materials being composted, whether facilities are indoor or outdoor, the processes performed on-site, and seasonal variations.

Methods: In six facilities treating green waste and six facilities treating sewage sludge, ambient aerosols were sampled for 90 minutes on three consecutive days in summer and winter. The 6 sampling points were located near points where composting activities were performed, and at one control point. The concentrations of thermophilic fungi (cultivated at 47°C on Malt Extract Agar for three days) and of thermophilic bacteria (cultivated at 56°C on Tryptone Soy Agar for three days) were determined. Endotoxin concentrations were measured using the Limulus Amebocyte Lysate method.

Results: All green waste facilities were outdoor facilities, whereas three of the six sludge facilities were indoor facilities. Aerosol sampling was performed in both winter and summer in all facilities, for a total of 504 measurements, resulting in 1512 concentration determinations.

These data will allow us to determine: whether microorganism concentrations are higher in summer than in winter; whether they are affected by the nature of the waste being composted; the impact of indoor or outdoor conditions, and of the on-site processes involved.

Discussion and perspectives: This study will provide information about the biological, allergenic and inflammatory airborne aerosols produced in composting facilities, and the risk they pose to workers’ health.
Hypersensitivity pneumonitis in a cluster of sawmill workers: a 10 years follow up of exposure, symptoms and lung function

Færden K. 1, Lund M.B. 2, Aaløkken T.M. 3, Eduard W. 4, Søstrand P. 1, Langård S. 1, Kongerud J. 2

1 Department of Environmental and Occupational Medicine, Oslo University Hospital, Norway
2 Department of Respiratory Medicine, Oslo University Hospital, Norway
3 Department of Radiology, Oslo University Hospital, Oslo, Norway
4 National Institute of Occupational Health, Oslo, Norway

Keywords: Hypersensitivity pneumonitis, sawmills, mould spore exposure, lung function

Introduction: The long-term prognosis of repeated acute episodes of hypersensitivity pneumonitis (HP) is not well described. The present paper reports on a 10 years follow up of a 10-person cluster from the trimming department of one Norwegian sawmill. All 10 subjects had experienced relapsing episodes of HP. The aims of the study were to evaluate symptoms, work-related sick-leave and pulmonary function.

Subjects and methods: The subjects were interviewed on work history, non-work-related exposures and smoking history. An interviewer-based questionnaire comprising information on symptoms and sick-leave was completed by the physician who interviewed each subject. IgG antibodies to Rhizopus microsporus antigens were measured in blood. Lung function tests included dynamic spirometry, determination of static lung volumes, gas diffusion capacity (DLCO) and exhaled nitric oxide (FeNO). High resolution computed tomography (HRCT) of the thorax was obtained at inclusion. During the observation period, seven series of measurements of mould spores and wood dust were carried out among the workers.

Results: At inclusion, HRCT scans demonstrated air trapping in five workers and one worker presented findings consistent with sub-acute or chronic HP. At follow up, symptoms had declined in all subjects. Sick-leave related to HP symptoms was, in general, low; at inclusion 0-20 (mean 3.5) days/year, and none at follow up. A significant increase was observed in median (range) DLCO 78 (71-112) vs 93 (74-111) % predicted (p=0.03). The air levels of mould spore were reduced from 2001 to 2009 by a factor of 50-100.

Conclusions: HP symptoms gradually declined, sick-leave was reduced and gas diffusion capacity improved - parallelising the gradually reduced air levels of mould spores. Like for Farmer’s lung, most cases of HP among wood trimmers seem to present a mild course.
Inhalation exposures to respiratory sensitizers and irritants among professional cleaning workers

Gerster F.M., Hopf N.B., Wild P., Vernez D.

Institute for work and Health (IST), University of Lausanne
Lausanne, Switzerland

Keywords: Asthma, occupational exposure, professional cleaning, respiratory sensitizers and irritants

A growing number of scientific studies have strengthened the association of asthma and other adverse respiratory effects in cleaning workers. Professional cleaning may cause airborne exposures to several respiratory sensitizers and irritants often used as surface active agents or perfumes. However, little quantitative exposure information is available. The aims of the present work were to characterize sensitizers and irritants in cleaning products, and to measure air concentrations of 10 identified substances of interest, among cleaners.

A survey, regarding the use and consumption of cleaning products, was sent to cleaning companies in Switzerland (n=1476). The 135 most used cleaning products were selected based on results of the survey. The material safety data sheets for these products were reviewed in order to identify the sensitizers and irritants to which the cleaners are potentially exposed. Based on these results, 10 substances were selected for the air sampling campaign in the cleaning sector. In addition, the risk factors for increased airborne exposures were investigated. Concentrations of two sensitizers (monoethanolamine and formaldehyde) and 8 irritants (benzyl alcohol and seven glycol ethers) were determined. For monoethanolamine a specific sampling and analytical method was developed.

The material safety data sheet analysis showed that 61 products (82%) contained at least one substance labeled as an irritant. 233 personal and 60 stationary air samples were collected during cleaning activities in hospitals, schools, offices, apartments, new constructions as well as in one shopping center and one workshop hall. Cleaning activities were general surface cleaning, floor stripping and waxing, window cleaning, bathroom cleaning, scrubber drying and floor mopping. Sampling time varied between 30min and 5h. Results show simultaneous occupational exposure to sensitizers and irritants released during products used. During one cleaning activity, 6 personal air concentrations were at the occupational exposure limit for 2-buthoxyethanol (111-76-2). The two main reasons for this increase in air concentrations were incorrect dilution of the concentrate and more frequent use of the work solution. Overall, air concentrations measured were mostly below 10% of the occupational exposure limits.

Overall exposures among cleaners were low, except during improper dilution and over use of product. For further investigation of occupational asthma among cleaners, the potential effects of simultaneous exposure to both irritants and sensitizers, identified in our study, should be taken into account.
Contact and respiratory sensitizers can be distinguished by IL-4 receptor alpha expression and IL-2 production

Goutet M., Pepin E., Langonné I., Huguet N., Ban M.

French National research and safety institute (INRS), Pollutants and Health division,
Rue du Morvan, CS 60027, 54519 Vandœuvre-lès-Nancy Cedex, France

Keywords: Chemical contact and respiratory sensitizers, flow cytometry, CD124, IL-2

Respiratory and contact allergies are among the most frequently encountered occupational diseases. To prevent these diseases, the chemical compounds responsible must be identified. In a previous project, we used flow cytometry to compare the immune responses induced in mice by trimellitic anhydride (TMA) and 2,4-dinitrochlorobenzene (DNCB), which are known respiratory and contact sensitizers, respectively. Our results revealed differences in expression levels for immunoglobulin E (IgE), major histocompatibility complex class II (MHC-II), interleukin 4 receptor (CD124), and intracellular production of IL-2 and IL-4. In this study, we have extended analyses to a range of products including known allergens (eugenol, hexyl cinnamic aldehyde, metal salts, isocyanates), irritants, and the reference molecules TMA and DNCB.

The different compounds were applied to the skin of mice at doses of comparable immunogenic potential. The draining lymph node cells for the site of application were analyzed 13 days after the first application. Flow cytometry was used to study the parameters of immune responses.

Analysis revealed two main markers differentiating the two types of allergens:

1) A marker specific for respiratory allergens, the IL-4 receptor (CD124). CD124 expression on T lymphocytes increased almost 2-fold with all the respiratory allergens tested; with contact allergens, it increased by between 1.2 and 1.4, while with irritants it was similar to control animals.

2) A marker specific for contact allergens, IL-2. IL-2 production increased with contact sensitizers and irritants, whereas it tended to decrease with respiratory sensitizers.

These two markers were stably expressed, with minimal differences between animals or between experiments. This means they could be used to differentiate sensitizers in animal tests, which could be applied to new chemical molecules prior to their introduction into occupational settings.
First evidence of occupational asthma induced by argan powder

Paris C. 1, Hérin F. 2, Penven E. 1, Poussel M. 2, Jacquenet S. 4, Poussel C. 1, Guidat C. 5, Thaon I. 1, Barbaud A. 6

1 Occupational Pathology Consultation Centre, University Hospital, Vandœuvre-lès-Nancy, FR
2 Occupational Pathology Consultation Centre, Toulouse University Hospital, Toulouse, FR
3 Functional Explorations Division, Nancy University Hospital, Vandoeuvre Les Nancy, FR
4 GENCLYS Laboratory, Vandoeuvre Les Nancy, FR
5 Association Lorraine de Santé et Médecine du Travail, ALSMT, Nancy, FR
6 Dermatology Department, ADERME Unity, Nancy University Hospital, Vandoeuvre les Nancy, FR

Keywords: Occupational asthma, argan, specific challenge test, vegetable proteins

Respiratory symptoms appeared in workers from a cosmetic factory handling argan cakes. Nine of these workers were examined in our occupational diseases department.

Methods:

Industrial process. 25 kg untreated argan cakes (as granules) arrived from Morocco in jute bags. Argan cakes were first milled to a fine powder, then solubilized, filtered and sterilized. They were then transformed into a sterile final product, either in a powder or a liquid form. To mimic the different steps of the process, operators were exposed to the four forms of the product (granules, powder and sterile powder or liquid).

Clinical, functional and laboratory examinations

All patients provided their informed consent for investigations, and for result publication. A standardized questionnaire was used to collect personal medical history, including past allergies and atopy, work-tasks, and smoking habits. A first series of tests was then performed, comprising clinical and functional respiratory examinations, blood tests (total IgE, immunoblotting for argan-specific IgE), prick-tests (PT) with argan powder and selected plant allergens, peakflow was recorded using OASYS 2 © over 3 weeks, including an exposure period. Patients with suspected occupational asthma based on these data underwent a methacholine challenge test. If asthma was confirmed, a specific challenge test with argan powder was performed, using lactose powder as control. The allergens recognized by specific antibodies were analyzed by tandem mass spectrometry (Orbitrap XL) to allow searches for analogous peptide sequences in plant databases.

Results: Of the 9 workers tested, 4 exhibited rhinitis and/or asthma when handling argan powder; to date prick tests have been performed on only three subjects. All 3 subjects reacted positively to common respiratory allergens and hazelnuts; 2 of them reacted to an argan solution. All four subjects with rhinitis and/or asthma underwent a specific challenge test with argan. This confirmed the presence of occupational asthma for three of the subjects.

Sequencing analyses revealed analogies between the allergens recognized by specific IgE and three groups of plant proteins known to be responsible for allergies. Specific recombinant allergen assays are on-going, and results will be communicated during the congress.

Conclusion: We report the first evidence of occupational asthma due to argan powder, proved by a specific challenge test for three workers in the cosmetic industry. The first structural results suggest that this allergy is induced by a plant protein analog.
An epidemic of allergic contact dermatitis in a metalworking shop

Penven E. ¹, Poreaux C. ², Studer M. ², François F. ², Barbaud A. ¹,², Paris C. ¹

¹ Occupational Diseases Clinic, Nancy University Hospital, Vandoeuvre lès Nancy, France
² Dermatology Department, Unité ADERME, Nancy University Hospital, Vandoeuvre lès Nancy, France

Keywords: Epidemic, occupational contact dermatitis, metalworking, prevention

Introduction: Occupational contact dermatitis frequently occurs in the metalworking industry, where repeated and cumulative contact with metalworking fluids containing both irritants and allergenic agents facilitate its emergence. We report on a series of contact dermatitis in a grinding shop. This report illustrates the complexity of the diagnostic approach and the importance of prevention in this occupational sector.

Patients and methods: Between March and May 2012, six workers (out of 10) who had worked in the same metalworking shop for at least one year consulted our occupational medicine department. All 6 patients reported the appearance of work-related hand and forearm dermatitis over the last year. None of them had a medical history of allergy. Five patients explained that the symptoms began after changes were made to the metalworking fluid and biocides used in the workshop. None of the workers usually wore protective gloves. All patients were patch-tested using the European standard series (ECDRG), as well as more specific tests including metals, industrial oils and rubber, and the products used in their occupational environment.

Results: Five workers were sensitized to at least one occupational product. Three were sensitized to metalworking fluid, one reacted specifically to tall oil resin, and another had probably become sensitized to N-methyldiethanolamine. Four patients were sensitized to one of the biocides present in the fluid. Finally, only one was sensitized to metals. Chemical measurements in the metalworking fluid revealed very high concentrations of biocides, probably due to inappropriate fluid preparation.

Conclusion: Several cases of allergic contact dermatitis in 6 workers from the same factory related to exposure to a metalworking fluid are presented. To identify the allergens responsible more precisely, workers were patch-tested with each chemical component of the metalworking fluids and biocides, as provided by the fluid manufacturer. Although the medical history of all workers was similar, suggesting the direct role of the metalworking fluid, patch-tests revealed sensitization to different agents contained in the fluid. As a result, we hypothesize that these sensitizations were favoured by a unique and prolonged exposure to an irritating metalworking fluid, and that high concentrations of biocides may have triggered the reaction. This series illustrates that close collaboration with the fluid manufacturer is necessary to identify the individual allergens responsible for sensitization in a complex fluid. It also highlights the need for appropriate prevention in the metalworking industry to limit contact with irritants and allergens.
Comparison between exhaled breath condensate and urine to assess occupational exposure to beryllium

Radauceanu A. 1, Hulo S. 2,3,4, Edmé J.L. 2,3,4, Grzebyk M. 1, Dziurla M. 1, Veillé M. 1, Bertrand C. 1, Sobaszek A. 2,3,4, Hédelin G. 1

1 French Research and Safety Institute for the Prevention of Occupational Accidents and Diseases (INRS), Rue du Morvan, CS 60027, 54519 Vandoeuvre-lès-Nancy Cedex, France
2 Univ Lille Nord de France. F-59000 Lille, France
3 UDSL, EA 4483. F-59000 Lille, France
4 CHU Lille. F-59000 Lille, France

Keywords: Occupational exposure, beryllium, exhaled breath condensate, biomonitoring

Background: Beryllium (Be) is a lightweight metal widely used in high-technology industries. Occupational exposure to Be by inhalation and dermal contact has been shown to lead to Be sensitization and pulmonary diseases. Exhaled breath condensate (EBC) has been used in occupational settings as a non-invasive means to assess target tissue dose and effects of some pneumotoxic metals. Since the lungs are the main target organ of Be toxicity, the present study investigated how Be levels in the EBC compare to urine levels in a population of occupationally exposed workers in France.

Methods: A total of 120 exposed and unexposed workers were recruited during the 2009-2011 period. The exposed group comprised 82 subjects (age 43.8 ± 8.9 years, 84% men) from machining and aluminum smelting plants. The unexposed group consisted of 38 subjects (age 44.4 ± 10.7 years, 58% men) with no significant history of lung disease and who were not occupationally exposed to Be. Prior to conducting EBC and urine sampling, each plant was inspected to confirm the use of Be in different forms (pure metal, alloys with copper 2 and 3%, alloy with aluminum 62%, soluble forms of Be), to gather data on work stations (presence or absence of ventilation devices, tasks performed) and work performed (job description, type of task). Data was collected at the workplace through responses to a standardized questionnaire related to subject's past and current medical history, tobacco use, work history and description of tasks performed; EBC was collected using a portable device (ECOSCREEN Turbo); spirometric and exhaled nitric oxide measurements were performed; and a single urine sample was collected. Be levels in urine and EBC were measured using electro-thermal atomic absorption; results were confirmed by inductively coupled plasma-mass spectrometry. The limits of Be quantification were 1 ng/l for EBC and 0.0064 µg/l for urine.

Results: Median EBC concentrations of Be and interquartile ranges were 2.10 (1.44–2.75) ng/l for exposed, and 1.78 (1.70–1.85) ng/l for unexposed subjects. Median urinary concentrations of Be and interquartile ranges expressed as a function of creatinine were 0.0121 (0.0071–0.0210) µg/g creatinine for exposed, and 0.0140 (0.0078–0.0258) µg/g creatinine for unexposed subjects. Thus, Be levels in EBC did not correlate with Be levels in urine.

Conclusions: Our study shows that EBC can be used to investigate lung tissue levels in workers exposed to Be. Not surprisingly, Be levels in EBC did not correlate with urine levels. This can be explained by the fact that urine biomonitoring reflects systemic occupational and environmental exposure, while EBC provides information directly related to lung levels, which do not necessarily reflect the absorbed dose, but are responsible for local inflammatory and oxidative effects. Different lung deposits and urine concentrations depend on the - partly unclear - dynamics of distribution, retention and excretion of Be, duration of exposure, past and current exposure, form of Be etc.
Protecting against exposure to moulds and thermophilic actinomycetes when operating a front-end loader in composting facilities

Schlosser O., Huyard A.

Suez Environment, CIRSEE, 38 rue du Président Wilson, 78230 Le Pecq, France

Keywords: Composting, fungi, actinomycetes, vehicle cab.

Composting involves decomposition of organic materials which is associated with the growth of thermophilic and/or thermotolerant bacteria and fungi, among which *Saccharopolyspora*, *Thermoactinomyces*, *Saccharomonospora*, *Thermomonospora* genera of actinomycetes, and *Aspergillus*, *Penicillium*, *Rhizopus*, and *Mucor* genera of storage fungi are particularly prevalent. Plant saprophytic moulds are also present, such as *Cladosporium* and *Alternaria* spp. To date, no specific epidemiological study has been performed to assess the risk of allergic diseases developing in composting workers. However, this risk is suggested by case reports of *A. fumigatus* - or actinomycetes-related hypersensitivity pneumonitis among workers exposed to compost aerosols.

One of the main tasks in composting facilities is vehicle operation when mixing materials, breaking down piles, screening, turning windrows and loading compost. The air quality inside vehicle cabs, in terms of microbial composition, is thus a major issue in health risk management. How the vehicle cab environment is protected against bioaerosol penetration in composting facilities is poorly documented. This study therefore aimed to further estimate how concentrations of airborne biological agents can be reduced inside cabs, particularly in front-end loaders.

Six front-end loaders were investigated, in four indoor or open-air sludge composting facilities. Four loaders were fitted with a pressurisation and high efficiency particulate air filtration system (PFS). The two others were only equipped with a pleated paper filter, with no pressurisation. All cabs were equipped with an air-cooling system. Air samples were collected simultaneously inside the cab and on the outside of the cab with a CIP 10-M sampler (Tecora); a total of 55 sample pairs were analysed. For cultivable mesophilic fungi, the highest mean reduction in fungal concentration was 99.78% (CI95% [99.68-99.87%]), estimated for a PFS-fitted loader purchased two months before performing tests. In the three other similarly equipped loaders, the reduction was between 92.89% and 94.71%. This difference is probably due to accumulation of spores inside the cab and/or leakage through the filter-sealing system. Inside the two cabs fitted only with a pleated paper filter, the mean reduction was markedly lower, at 71.45% and 85.12%, and the estimated uncertainty was also larger. In these cabs, the in-cab fungal concentration ranged from 540 to 7400 cfu/m3. These values should, however, be viewed in a workplace context, where the benchmark value associated with hypersensitivity pneumonitis is 106 cfu/m3. Thus, with 6 hours loader operation per day, it is quite unlikely that this value will be exceeded (<0.01%). However, for short-term respiratory effects due to fungi, only vehicle cabs fitted with a PFS provided efficient protection.

Thermophilic actinomycetes concentrations measured in one of the vehicle cabs fitted with a PFS also showed a high protection factor, with 99.34% reduction ([98.29-99.91%]).

Pressurisation and a HEPA filtration system can thus provide a high protection efficiency of the vehicle cab environment against fungi, and probably actinomycetes, in composting facilities, with 99% efficiency being a reasonably achievable goal provided the vehicle cab is cleaned regularly and thoroughly, overalls and shoes are changed frequently, and leaks in the filter-sealing system are limited.
Validation of an analytical technique to assay urinary chromium by atomic absorption spectroscopy (AAS)

Sedjelmaci N., Maameri K., Alamir B., Abtroun R., Reggabi M.

Toxicology Laboratory, Bab El Oued University Hospital, Alger
National Centre for Toxicology, Alger

*Keywords: Urinary chromium, occupational exposure, validation, biological monitoring.*

Occupational exposure to chromium is mainly observed in three industrial sectors: metallurgical, chemical and refractory industries.

An analytical technique must be designed, developed and validated to assay urinary chromium levels as part of biological monitoring for workers who are chronically exposed to chromium. This will help improve prevention through the development of appropriate protective measures.
Sampling and quantification of air borne antigenic/allergenic proteins from moulds


BMA-Labor GbR
Technologiezentrum Ruhr
Universitätsstrasse 142
44799 Bochum, Germany

Keywords: Allergens, air exposure, detection, AS 100 sampling head

Mould pollution as a consequence of interior dampness can be considered as a potential risk for human health. Especially allergic caused respiratory diseases can be regarded as a matter of priority in this connection. On the one hand medical diagnostics is still inadequately standardised in this field and on the other hand the environmental monitoring of airborne mould allergens is difficult when carried out with the standard filtration method. The evaluation of indoor mould pollution with regard to health is done up to now by the determination of the mould concentration and the determination of mould species. It is based on the qualities and effects of moulds, which have been investigated and reported already as being a potential risk for human health. This way of proceeding represents an indirect conclusion about a potentially existing risk for human health. The present study introduces the development of an optimized direct method for sampling and quantification of air borne allergenic proteins as pathogenic indoor and outside mould components. The basic principle of this method is direct sampling of the airborne particles and antigenic/allergenic proteins into the test receptacle, which is used for the following analysis (ELISA). For this purpose a special sampler has been made in cooperation with the company Umweltanalytik Holbach GmbH.

The results and the effectiveness of this sampling method were examined by an ELISA (MEL-Mix 1) test, which has been developed in our laboratory. With the MEL-Mix 1 ELISA the antigenic/allergenic proteins of three mould species, which are connected with indoor dampness (Aspergillus versicolor, Aspergillus penicillioides, Penicillium chrysogenum) and one species, which typically occurs outside (Cladosporium cladosporioides), are detectable. The first air samples, which were taken with the method described above show, that very low antigen/allergen concentrations (2,0 bis 4,6 ng/m³ air) were clearly detectable.

In summary the represented proceeding showed following advantages:
1. Using the test container also as sampling matrix additional preparation steps are avoided and therefore loss of sample is minimized
2. Low allergen concentrations, which may be relevant for sensitization or induction of allergic symptoms are detectable within a sampling time of 20 min
3. By direct detection and quantification of antigenic/allergenic mould proteins a well-directed evaluation of a potential risk for human health is possible
4. The sampling procedure described above may not only be used for the detection of mould allergens but also for the detection of other airborne allergens.
5. Future measurements of airborne allergens in practice are necessary to derive correlations between medical results and environmental pollution
6. The suitability of the represented sampling procedure in practice could be confirmed by the results of the quantification of antigenic/allergenic mould proteins of the MEL-Mix 1 ELISA. Additionally the represented sampling equipment has to be verified with regard to its biochemical/physical efficiency.
Consultations for occupational dermatitis show that the risk of developing allergy appears higher in three professions: hairdressing, metallurgy and health professions.

Of patients presenting with occupational dermatitis in the last 18 months at Besançon University Hospital, 17 were hairdressers. Most (n=16) were women, median age was 26 (average age 27.5). Patients had been working for an average of five years and symptoms appeared after a mean of 21 months (median 8 months). Reactions were predominantly (ten cases) to paraphenylendiamine (PPD), with fewer reactions (nine cases) to other allergens, including nickel. Ten subjects wore gloves, although seven did not wear them systematically, and only two wore them constantly. One hairdresser used disposable gloves and just one had her own gloves.

Better prevention therefore seems necessary. In Franche-Comté, two initiatives were undertaken to inform professionals about prevention: one in hairdressing schools and one with professional hairdressers.

A survey of students in hairdressing schools assessed awareness and preventive practices. Two hundred questionnaires were distributed. Among responses, 30% of students presented a reaction to nickel, and 30% had had a henna tattoo. Two-thirds protected their hands when dyeing hair, but only one-third used protection when applying perms, and 50% admitted to using gloves with holes. The same proportion used gloves on both sides (by turning them inside out), while up to 20% never used gloves. Half of students had already developed dermatosis, and only 60% tried to prevent skin problems (by applying creams, etc.). Students participated enthusiastically in the preventive training provided in the follow-up to the survey, although it consisted of just one session.

In 2011 and 2012, as part of the Pulmonary Pathologies in Agricultural Professions and Independent workers network, open meetings were held in Franche-Comté for hairdressers to raise awareness of occupational risks, including dermatitis. Invitations and information on these meetings were sent to hairdressers, primary care physicians (PCPs), chemists, hairdressing schools and the town halls of the areas where the meetings were held (1247 hairdressers, 117 chemists, 275 PCPs, 79 town halls and 11 hairdressing schools). Five meetings were held, but only 30 people attended (27 hairdressers, including one employee, two teachers and one primary care physician). This low turn-out by employers suggests a lack of interest in prevention.

Based on these data, we believe that the most appropriate time to address preventive measures is at the beginning of hairdressers' initial training. However, it is not enough to provide information just once during training. Ideally, the information should be repeated over the course of training, while simultaneously monitoring students. Prevention should be an integral part of training, i.e. the knowledge acquired during training should be assessed in the final examinations.

This training cannot be provided for the whole region every year by an allergist or occupational physician alone. Therefore, teachers and work placement mentors should be trained to help pass on information about how occupational skin diseases can be avoided.
Hand dermatitis among healthcare workers: the role of isothiazolinones in hospital soaps

Tran N. 1, Pecquet C. 2, Guillon F. 1, Choudat D. 3

1 Avicenne Hospital, Paris Seine-Saint-Denis University Hospitals, AP-HP, Occupational and environmental diseases department, 125 rue de Stalingrad, 93009 Bobigny Cedex, France
2 Tenon Hospital, AP-HP, Dermatology, allergology centre, 4 rue de la Chine, 75970 Paris cedex 20, France
3 Cochin Hospital, AP-HP, Broca-Hôtel Dieu Occupational medicine clinic, 27 rue Faubourg Saint-Jacques, 75014 Paris, France

Keywords: Contact eczema, methylisothiazolinone, healthcare workers, soaps

Contact dermatitis, also known as contact eczema, represents 20 to 30% of all hand dermatitis and 9 to 35% of job-related health conditions. This condition is most prevalent among healthcare workers, hairdressers, and those working with heavy metals. Preservatives are known to be one of the causal agents. Many cosmetic and industrial products include a mixture of methylchloroisothiazolinone and methylisothiazolinone (MCI/MI), with a weight ratio of 3 to 1 (i.e., Kathon® CG), as a preservative. The MCI/MI mixture was first shown to cause allergic contact dermatitis among hairdressers and painters in the 1980s. However, its effect on healthcare workers has yet to be documented.

We present a descriptive, retrospective study among public healthcare workers who consulted for dermatitis of the hands between 1996 and July 2010, in a non-professional dermato-allergological center. Hospital soaps were thought to be the main cause.

Fourteen patients (10 women and 4 men), average age 35 [21-62], were included in this study. Participants were nursing staff, midwives, surgeons, and physical therapists. Five patients reacted positively in tests to Anios® Doux Haute Fréquence soap. One participant reacted to Aniosoft Manuclear NPC® soap in tests. Contact dermatitis in three out of 14 patients was due to the MCI/MI mixture found in the Anios® soap, shown by a positive test to both the MCI/MI mixture alone and the Anios® soap.

Occupational dermatitis due to the MCI/MI mixture is also prevalent among heavy metal workers, construction workers, workers in paint and glue industries, workers handling oils and adhesives, hairdressers, printers, imaging technicians, photographers, cosmetic lab workers, workers in the textile industry, water treatment specialists, and milk inspectors. To our knowledge, this is the first series documenting allergic conditions associated with the MCI/MI mixture found in hospital soaps. This series is not representative of the prevalence or the incidence of hand dermatitis associated with MCI/MI mixtures in the healthcare industry.

This study reports on cases of hand dermatitis associated with the MCI/MI mixture found in the Anios® Doux Haute Fréquence hospital soap. This study draws attention to a job-related condition that might otherwise be ignored by occupational physicians, it sensitizes occupational health providers to the existence of allergies to the MCI/MI mixture, and highlights the role that should be played by occupational physicians when selecting soaps for use in the workplace, including in the healthcare industry. Prospective studies to determine the sensitizing power of preservatives, such as the MCI/MI mixture, in rinsed products and within the context of repeated exposure, are necessary. This type of prospective study could lead to changes in the current regulations.
AUTHOR INDEX

A

Aaløkken T.M. .............................................. 53
Abtroun R. .................................................. 60
Afanou A.K.J. ............................................. 29
Agius R. ...................................................... 44
Alamir B. .................................................... 60
Alenius H. .................................................. 13
Ameille J. .................................................... 37, 48
Anua, SM .................................................... 26
Aubin F. ...................................................... 62
Aubin S. ...................................................... 27

Baldwin P. .................................................... 25
Ban M. ......................................................... 46, 47, 55
Barbaud A. .................................................. 22, 56, 57
Barretta F. .................................................... 18
Bastos H. ...................................................... 33
Bensaid B. .................................................... 32
Bensefa-Colas L. .......................................... 37, 44, 48
Bérard F. ...................................................... 32
Bertrand C. ................................................... 38, 58
Bonthoux F. ................................................... 41

Cantineau A. ................................................. 19
Cantone L. .................................................... 18
Charrière N. .................................................. 28
Choudat D. ................................................... 37, 48, 63
Cleenewerck M.B. ........................................ 48
Cloutier Y. .................................................... 27
Coulais C. .................................................... 51, 52
Crépy M.N. ................................................... 37
Crépy M.N. ................................................... 48
Cruz M.J. ...................................................... 25

Danuser B. .................................................... 17
Davolos D. .................................................... 50
de Blay F. ..................................................... 19
de Lentdecker C. ......................................... 33
Delattre C. .................................................... 32

Demange V. ............................................... 51, 52
Descatha A. ............................................... 37, 48
Dick F. ........................................................ 26
Donnay C. ................................................... 19
Doriotte M. ................................................... 38
Dorribo V. .................................................... 17
Ducloux S. ................................................... 62
Dupont P. .................................................... 21
Duquenne P. ............................................... 51, 52
Dziurla M. ................................................... 38, 51, 52, 58

Edmé J.L. ...................................................... 38, 58
Eduard W. ................................................... 24, 29, 53
El Ali Z. ....................................................... 35
Esser P. ....................................................... 35
Evans G. ..................................................... 25, 26, 30, 42

Faerden K. ................................................... 53
Fastier A. .................................................... 33
Faye S. ....................................................... 44
François F. ................................................... 57
Fraser S. ..................................................... 42

Gagné S. ...................................................... 27
Garner R. ..................................................... 21
Geier J. ....................................................... 34
Gérardin, F. .................................................. 43
Gerbeix C. ................................................... 35
Gerster F.M. .................................................. 54
Girardin P. ................................................... 62
Goguey M. ................................................... 62
Gonzalez M. ................................................... 19
Goutet M. ..................................................... 46, 47, 55
Green B.J. .................................................... 29
Griffin P. ..................................................... 26
Grzebyk M. .................................................. 38, 51, 52, 58
Guichard Y. ................................................... 46
Guidat C. ..................................................... 56
Guillemot M. ................................................. 37
Guillon F. ..................................................... 63
Guilloux G. ................................................... 19
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Halstensen A.S.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Nicolas J.F.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Hédelin G.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Niculita-Hirzel H.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Heine K.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Nies E.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Helleur R.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Nosbaum A.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Hérin F.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Héry M.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Hjeljord L.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Honnert B.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Hopf N.B.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Huguet N.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Hulo S.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Humbert P.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Huyard A.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Kalberlah F.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Kerdine-Römer S.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Kongerud J.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Kopfenschmitt M.Ch.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Krief P.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Laborde-Castérot H.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Langard S.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Langlois E.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Langonné I.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lasfargues G.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Leghissa P.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Legrand J.J.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lenieff V.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Luc A.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lund M.B.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Maameri K.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mark D.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Marraccini P.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Marsili C.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Martin S.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mason H.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Matzinger F.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mélin S.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Morton J.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mosconi G.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Moumane M.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mutet V.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Occupational Allergies**

Nancy 3-6 April 1979

65
Stagg S................................................................. 26
Stephan U............................................................. 61
Stocks S.J.............................................................. 44
Studer M............................................................... 57

T
Telle-Lamberton M.............................................. 44
Tennstedt D.......................................................... 48
Thaon I................................................................. 56
Thiebaut A............................................................ 62
Thorpe A............................................................... 42
Tran N................................................................. 63
Travers C............................................................. 62
Tronsmo A........................................................... 29

V
Veillé M................................................................. 38, 58
Velten M............................................................... 19
Vernez D.............................................................. 54
Vocanson M.......................................................... 32

W
Waton J................................................................. 22
Wild P................................................................. 17, 54

Z
Zerbib D............................................................... 48
Abstracts

Contact
allergiepro2013@inrs.fr

3 • 4 • 5 April 2013
Palais des Congrès, Nancy, France

INRS Occupational Health Research Conference 2013

Occupational allergies

INRS SCIENCE CONFERENCE ROUND