The Chemist Towards Europe and the World

International Lectures at EXPO Milano 2015

EXPO MILANO 2015

CONSIGLIO NAZIONALE DEI CHIMICI
PRESSO IL MINISTERO DELLA GIUSTIZIA

EuCheMS
European Chemical Sciences

Introduction

On the occasion of EXPO 2015 a series of lectures have been jointly organized by the Chemical Association of Lombardy, representing the Consiglio Nazionale dei Chimici, together with EuCheMS, the European Association for Chemical and Molecular Sciences. The purpose was to inform visitors of Expo about the role that chemists and chemistry have in agriculture, water processes, feeding and energy. It was an amazing opportunity to raise awareness to the importance of the chemical sciences in society. With these objectives in mind, seven lectures and one summarising conference have brought together experts with a wide range of backgrounds. This publication collects the short abstracts from each of the lectures as well as some comments from the audience.

Sergio Facchetti,
Consiglio Naziolane dei Chimici

Ulrich Schubert,
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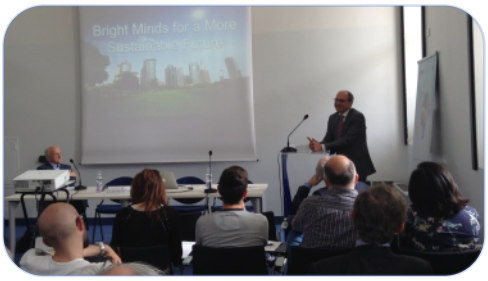
Towards a Circular Economy? Catalysis for the Production of Biomass-Based Building Blocks | May 11, Palazzo delle Stelline | *Bert M. Weckhuysen - Debye Institute for Nanomaterials Sciences Utrecht University, the Netherlands*



Lignocellulose is becoming an increasingly important alternative feedstock for the manufacturing of bio-based fuels, chemicals and material production.
Modern lignocellulosic biorefineries should produce base and fine chemicals as well as transportation fuels and materials, making use of all the major components of lignocellulose. Advances in making biomass-derived butadiene (starting from bioethanol, which can be produced from the hemi-cellulose fraction of biomass) and phenolics (starting from lignin) are also discussed. Lignin being a complex aromatic polymer, the catalytic conversion of lignin is highly challenging. A generic method for catalytic lignin valorization for the production of value-added aromatics or phenolics needs to address the issues of lignin solubility as well as of the subsequent depolymerisation, deoygenation and functionalization of the lignin soup. Another important aspect includes the issue of catalyst stability under aqueous conditions at elevated temperatures.

Questions and Comments

• At present the cost of biomass is higher than shale oil.

• It would be useful to know how much time it will take for catalytic technologies on biomasses to become part of the industrial activity in a viable manner, without subsidies.

• The depolymerisation of lignin, in particular into BTX, requires severe conditions and is energy consuming. Therefore, it should be taken into consideration the potential of such an approach also on large scale.

• Among the separation technologies tested before and after the catalytic processes it will be important to know which one will emerge to be the more efficacious for manufacturing products at high purity and at low cost.

• As a result of the current research, it is possible that in the future biomass will be used as a source for food.

Where Food Begins: The Role of Soils for Food Security and Food Safety | June 11, EU Pavilion | *Luca Montanarella- European Commission, DG JRC-Ispra, Italy*

Humans obtain more than 95% of their food from soil. Total available land surface on planet earth is limited and cannot be expanded. Therefore, there is the need to protect the available fertile soils from degradation processes and preserve the basis for food production for future generations. There is also the need to assure soil quality for sufficient food production for the growing global population (food security) while maintaining a high standard of quality and health of the food we consume (food safety). Healthy soils can produce healthy food for all of us if we care for this precious non-renewable natural resource.

Questions and Comments

• Nourishing the Chinese population (1.4 billion people) means giving food to 20% of the world population, while China has only 15% of the world´s arable land. Moreover, during the past thirty years another 1.5% of China´s total territory were used for construction.

• Today 40% of the corn produced in America is not used to feed people, but to produce biofuels. It is quite shocking to think that the amount of cereals required to fill the tank of a Sport Utility Vehicle (SUV) (240 kg) could feed a human being for a whole year.

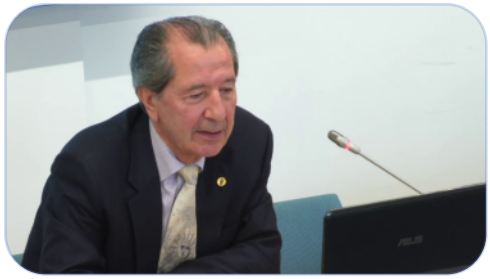
• Agriculture is a complete "system" based on inter-related factors. In order to maintain ecological balance and health, it should be understood how that system works as a whole.

• The correlation between unsustainable agriculture and climate change has one of the most direct effects: over the past two centuries the change in land use has transformed the biosphere, resulting in 70% of pastures, 50% of savannahs, 45% of temperate forests and 27% of the tropical rain forests being converted for other purposes. Between now and 2030 it is predicted that there will be an increase in urban areas of 1.2 million square kilometres, the size of South Africa.

• The quality of the food greatly depends on the quality of the soil. The most critical components of the soil are the microorganisms that thrive in it and that allow the plants to use the nutrients present in the soil.

• Since 1970 the world population is unable to limit the annual consumption to what nature is yearly producing. Each year we use up the reserves before the end of the year. This year the "overshoot day" has been at the middle of August.

Chemical Safety of Foods and Drinks | June 23 EU Pavilion | *Valery S. Petrosyan, Research Center " Ecology and Health" Chemistry Department, Moscow State University, Russia*



Persistent Organic Pollutants (POPs) production and use is forbidden by the Stockholm Convention, as well as the Persistent Toxic Substances (PTS). Possible contamination of food and drinks with POPs or PTS is a major concern and demands the most serious attention from public authorities as well as from the general public.

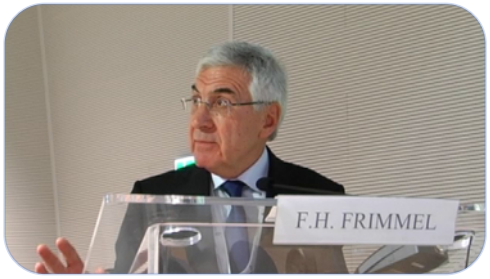
Questions and Comments

• We should drink substantial amounts of mineral waters, from about 1.5 to 3 litres per day to "renovate" our organism. The important thing is that the water we drink contains cations (K^+, Na^+, Mg^{2+}, Ca^{2+}) and anions (I^-, F^-, SiO_3^{2-}, HCO_3^-).

• Glyphosate is the active ingredient of a multinational non-selective herbicide. Herbicides and pesticides are metal chelators, which means they immobilize specific nutrients rendering them unavailable to the plants and any animal or human who consumes that plants.
In a recent evaluation from March 2015, the International Agency for Cancer Research (IARC), came to the conclusion that glyphosate should now be classified as a carcinogen substance in Group 2A (probably carcinogen to humans) based on "limited evidence" in human-experiments and "sufficient evidence" in animal-experiments. This classification was published in a short report in the "Lancet" journal on 20 March 2015. On the contrary a report of the German Institute for Risk Assessment (BfR) to the EU, based on the evaluation of over 30 epidemiological studies, came to the overall assessment that there is no validated or significant relationship between exposure to glyphosate and an increased risk of non-Hodgkin lymphoma or other types of cancer.
In conclusion, BfR will perform a thorough review of the classification issued by IARC once the monograph becomes available. In the meantime, in Europe a petition is in progress to suspend the use of this substance according to the precaution principle.

• Quite often the term "genetic engineering" rings alarm bells in people, probably due to a widespread prejudice. One of these prejudices is the mistaken belief that science and technology are a danger to food safety and the more a food is "natural" then the more it is healthy and that is certainly not always true.

Water Basis for Life | September 2 EU Pavilion | *Fritz H. Frimmel, Karlsruhe Institut for Technology (KIT), Germany*



Water is ireplaceable for life. Mankind faces a severe shortage of the vital fresh water. Therefore, a careful management of water concerning quantity and quality is indispensable. Protection of water and its responsible usage- including reuse- are essential for sustainability of human health. Proper water and waste-water treatment desalination of brackish and sea water have contributed to a need for technology to tackle the problems. This leads to the eminent challenge for arid and semiarid areas in Africa and in parts of Asia where the limited availability of water combined with growing population causes severe stress. This has to be seen in a global dimension and in close connection to energy consumption, environmental impact, climate change and social acceptability. Capacity development needs to include the understanding of the hydrological cycle, virtual water balances as key for the benefit/risk assessment of our industrial production and open discussion of principles for water ethics as prerequisites for a sound life of our generation and the generations to come.

Questions and Comments

• In many African Countries only about 50% of people have fresh water, something which carries serious consequences for health. As a first priority, technicians from these countries should be trained in European Countries, afterwards Europe should work together and make a contribution towards the construction and operation of appropriate plants.

• We should remember that there are also problems of water shortage in the plains of North China, due to intensive exploitation industries.

• The highest consumer of fresh water is agriculture. Through its use of nutrients the agricultural sector is also polluting fresh water, particularly in high production areas. This is notably of concern in the European Union, where nutrient cycles have been drastically accelerated by agriculture.

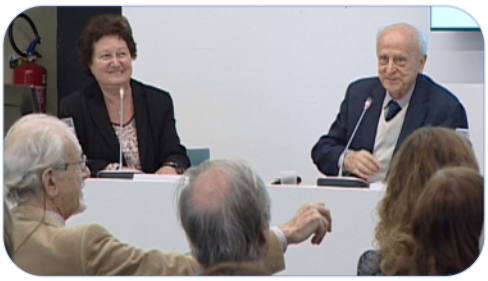
• It has been calculated that producing one kilo of meat requires 20.000 litres of water, while it only takes 1.000 litters to make one kilo of cereal.

• To compensate the lack of water, countries need to import food. This food is often called virtual water, its amount is what was needed to produce food elsewhere.

• At present the water is treated and re-used by the majority of industries.

• It should be underlined that even if the water stays on the top of many political agendas, the priorities of water issues are everywhere repeatedly sacrificed to supposedly more important policy issues.

Molecular Secrets of the Italian Gastronomy | September 29, EU Pavilion | *Rosangela Marchelli, Departement of Organic and Industrial Chemistry. University of Parma, Italy*



Gastronomy has been always considered an art as well as an empirical technique based on experience and tradition. The word "chemistry" was generally avoided when speaking of food on account of the identification with "un-natural" additives or sophistication. Indeed, the popular perception of food contamination was preferentially linked to chemicals such as pesticides and dioxins despite the higher risk presented by microbial contaminants or natural products of moulds such as mycotoxins. Chemistry can help to understand what makes a food pleasant and how the food is transformed during the cooking procedure in order not only to be appreciated by the consumers but also to be safe and to maintain its nutritional value. Some molecular secrets of the "Italian traditional gastronomy" are unveiled trying to demonstrate how gastronomy and science can collaborate in order to rationalise what is happening during cooking or what gives particular colour or flavour or taste to our foods.
The eventual presence of allergens in all ingredients used is reported according to the EU Regulation 1169/2011 enforced from the 13 December 2013.

Questions and Comments

• "Zero/km" food is something positive if the food is consumed in a short time.

• Chemistry is involved in studying the molecular characteristics of foods and food raw materials, how foods are technologically processed or cooked, devising new methods of detection concerning nutritional and toxicological aspects. From research institutes to control laboratories and regulatory agencies, chemistry is an indispensable tool in a comprehensive scheme of "Regulatory Science" in order to guarantee the citizens' health.

• Chemistry can help identifying fake food products. As example we can consider Parma ham. The colour of similar product is due to the addiction of nitrate or nitrite or nitrosylmyoglobine. In Parma ham these substances are absent.

• Food Allergy has become a "hot topic" threatening the citizens' health. The perception in the general population that the prevalence of this disease has been increasing in the last years, has prompted EFSA (European Food Safety Authority) to update a previous scientific opinion on the evaluation of allergenic foods and food ingredients for labelling purposes, recently published in EFSA Journal 2014; 12(11):3894.

• Novel Foods and Novel Foods Ingredients approved by EFSA are reported
in the Novel Food Catalogue, as well as products which did not meet the EFSA requirements.

Summarising outcomes of the International Lectures | 2 October 2015, Italy Pavilion |
Chaired by Armando Zingales, President of the Consiglio Nazionale dei Chimici; Rosangela Marchelli, Departement of Organic and Industrial Chemistry, University of Parma, Italy; Fritz H. Frimmel, Karlsruhe Institut for Technology (KIT); Sergio Facchetti, Consiglio Nazionale dei Chimici

These events have provided an important forum of exchange of ideas between scientists, young researchers and the general public, an exchange which is crucial for ensuring our future prosperity and well-being. These lectures also represented an ideal opportunity to raise the profile of the chemical sciences in research and innovation within the global challenge of food security. The challenge in "Feeding the Planet" is to identify real solutions to meet the needs of a global population that will reach 9 billion people in 2050 and for whom there will not be enough food and water and for a population that even today suffers from unacceptable injustice in food distribution. Out of a current population of 7 billion, there are 805 million of people suffering from malnutrition. On the other hand, there are the richer countries, whose emergency is overfeeding, which has led to a significant increase in obesity, diabetes, cardiovascular disease and cancer.
How can these two extremes be balanced? The Charter of Milan (http://carta.milano.it/) is a document about the right to food and clean water, about the fight against waste and about environmental sustainability. This is the most important intangible heritage from EXPO 2015. Such a document involves everyone: governments, institutions, business, associations and individuals who have been asked to add their signature. We must feed the world, while respecting the Earth on which we live and from which we get the essential resources we need to live. EuCheMS and the Consiglio Nazionale dei Chimici would like to thank to all of those who have put so much work into the preparation of these lectures.

About the Organisers

The Italian **Consiglio Nazionale dei Chimici** is a board of chemists under the Ministry of Justice with the responsibility of recognising and assuring the professional quality of chemists in Italy. Overseen by 15 counsellors, other than regulating the chemists´ labour market, the CNC also aims to raise the profile of professional chemists within the scope of the Italian Society.

EuCheMS, the European Association for Chemical and Molecular Sciences, aims to nurture a platform for scientific discussion and to provide a single, unbiased European voice on key policy issues in chemistry and related fields.
Representing more than 160,000 chemists from more than 40 Member Societies and other chemistry related organisations, EuCheMS relies on a unique network of active researchers involved in all the fields of chemistry. Through this network, EuCheMS organises several specialised academic conferences as well as the biannual EuCheMS Chemistry Congress, the European congress of chemical sciences. EuCheMS also promotes the role and image of the chemical sciences among the general public and policy-makers through social media, newsletters and through the organisation of conferences and workshops open to the society.
Through the promotion of chemistry and by providing expert and scientific advice, EuCheMS aims to take part of the solution to today´s major societal challenges.

The organisers would like to thank to the European Commission for supporting these lectures by allowing the use of the EU Pavilion. For a complete list of the events organised in the EU Pavilion please visit bit.ly/252jsgZ.

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