

Latin American microbiology at the independence bicentenary: the 20th ALAM Congress (Montevideo, 27-30 September 2010)

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In a hotel at Plaza de la Independencia, the big square between downtown and the historical city (*Ciudad Vieja*) of Montevideo, the 20th Latin American Congress of Microbiology (ALAM) took place on 27–30 September 2010 [www.alam2010.org.uy]. ALAM 2010 brought together some 1000 microbiologists from 19 countries, including 12 Latin American countries (Argentina, Bolivia, Brazil, Colombia, Cuba, Chile, Ecuador, Mexico, Paraguay, Peru, Uruguay, Venezuela, Portugal, Spain, Australia, Netherlands, USA, UK and France). ALAM 2010 was held in conjunction with the 9th Meeting of the Uruguayan Society for Microbiology. The program covered a wide range of scientific topics dealing with

clinical, pharmaceutical, food, environmental, agriculture and forest microbiology, and microbial biotechnology. Over 800 posters were presented. The meeting was organized by the Latin American Association for Microbiology (ALAM) [1,2] and the Uruguayan Society for Microbiology (SUM). Matilde Soubes, vice-president of ALAM, chaired the meeting. The inaugural address—“Microbiology for the 21st century: *E pluribus unum*”—was given by Ricardo Guerrero, president of the Spanish Society for Microbiology (SEM). The inspiring lecture focused on microbial diversity and the role of microorganisms in nature, a very suitable topic to be discussed in 2010, the International Year of Biodiversity.

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Microbial-caused diseases

In the last years the exposure to emerging pathogens has increased due to climate change, urbanization, globalization, increasing international trade and travel, lifestyle changes, and closer interactions with animals. Latin America has the highest number of cases of dengue in the world. Brazil reported almost 1 million cases in 2010, whereas more than 100,000 cases were reported in Colombia and in Venezuela. The geographical distribution of dengue in Latin America has increased (D. Enria, Argentina) and now also includes Argentina, Bolivia, Paraguay, Ecuador, Panama, Costa Rica, Nicaragua, Honduras, El Salvador, Guatemala, Mexico, Dominican Republic and Puerto Rico. This infection is caused by a *Flavivirus* that is transmitted by *Aedes* mosquitoes. To prevent the spreading of the disease, the control of the vectors is vital. However, a vaccine would be the most effective measure to overcome this disease in the near future. Advances in the development of a dengue vaccine were presented (C. Nunes, Brazil).

Tuberculosis is a major re-emerging disease, with an associated high mortality in Latin America. This often deadly infectious disease is caused by various strains of mycobacteria, usually *Mycobacterium tuberculosis*. The genome of *M. tuberculosis* and related bacteria has been sequenced. To understand the genes involved in virulence, pathogenic and non-pathogenic *M. tuberculosis* isolates and mutants were studied with genetic methods and bioinformatic tools (M. Zambrano, Colombia). The taxonomy of the studied isolates remains unchanged. Specific genome regions containing genes responsible for pathogenicity were discussed.

The Latin American laboratory network SIREVA collects surveillance data on main pediatric infectious diseases such as meningitis, pneumonia and influenza caused by *N. meningitides*, *S. pneumoniae* and *H. influenzae* in Latin American countries (S. García, Argentina). These epidemiology and laboratory data are of utmost importance in making political decisions regarding vaccine programs.

Enteropathogenic *Escherichia coli* and *Salmonella enterica* serotype Typhi are still major causes of infectious diseases in Latin America. At ALAM 2010, various aspects of the fight against this pathogen were discussed. They included the establishment of a Latin American coalition for *E. coli* research (A. Torres, USA); the characterization of an atypical enteropathogenic *E. coli* (T. Gomes, Brazil); the negative effect of enteropathogenic *E. coli* on the cytoskeleton and its proteins (e.g., fodrin) (F. Navarro-García, Mexico); the role

of genomic islands and the loss of function of pseudogenes involved in the pathogenicity of *Salmonella enterica* serotype Typhi (G. Mora, Chile), the use of *Salmonella enterica* serotype Typhimurium as a model to study the bacterial infection of fibroblasts (F. García-del Portillo, Spain); the activation of the two-component regulatory system PhoP-PhoQ by the pathogen to control host growth; and the presence of proteins involved in gold (GolS) and copper (CueR) resistance in *S. enterica* serotype Typhimurium strains (F. Soncini, Argentina).

The discovery that *Helicobacter pylori* causes gastric ulcers and stomach cancer deserved a Nobel Prize in Physiology or Medicine (awarded to Barry J. Marshall and J. Robin Warren in 2005). This microbe has world-wide distribution, and the population it colonizes ranges from 20% in developed countries to 90% in some regions of Latin America and North Africa. To study the relation of *Helicobacter pylori* genotypes and illness, marker genes for evolution were analyzed in isolates of different patients (M. Catalano, Argentina). Some hosts contain *H. pylori* strains with different genotypes.

In addition to dengue, other viral infections were also discussed. Regions with the highest incidences of Hantavirus include Argentina, Chile, Brazil, and Panama. Hantavirus has been detected and characterized in Brazil (J. Arbiza, Uruguay). Other virus-causing emerging diseases including the Hepatitis E virus (S. Mirazo, Uruguay) and the virus of respiratory diseases (F. Polak, Argentina) were also reported.

Antibiotic resistance

The increasing antibiotic resistance of bacterial pathogens observed worldwide is a great concern. Antimicrobial resistance is subjected to surveillance in many countries of Latin America. The sensitivity of bacterial strains to different antibiotics is generally analyzed by antibiogram assays, whose application was discussed (J. Zurita, Ecuador). The mechanisms of beta-lactam antibiotic resistance and the increasing numbers of *Klebsiella pneumoniae*, *E. coli* y *Proteus mirabilis* strains that produce beta-lactamases (G. González, Chile) were analyzed. The First Latin American Integron workshop, with the participation of experts in medical microbiology, microbial genetics and molecular epidemiology, was included in the scientific program of ALAM 2010. The workshop was a framework for regional researchers to meet and discuss scientific and technical aspects of integron research. LATINA, a net-

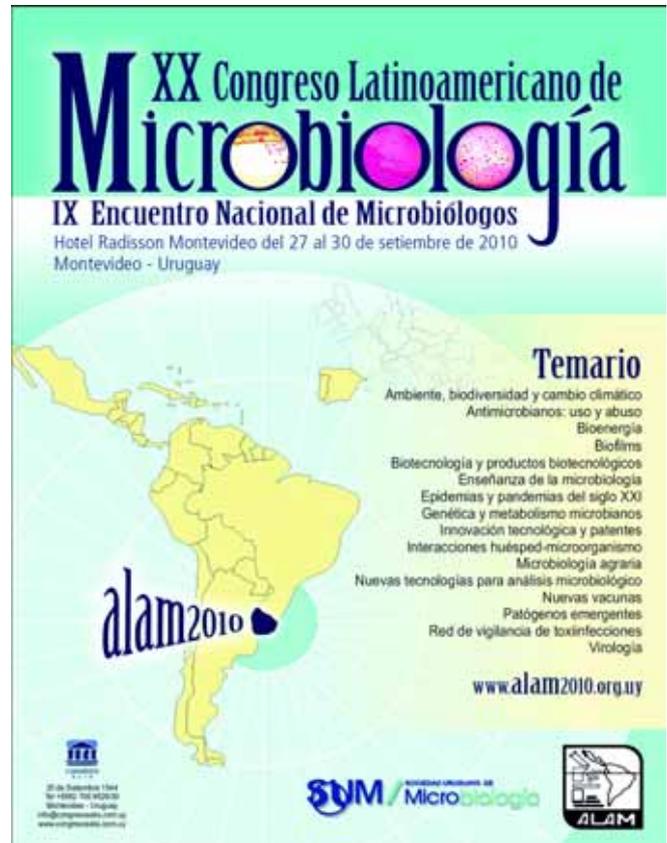
work of Latin American laboratories carrying out integron research, is committed to enhance the understanding of the mechanisms involved in both clinically important antibiotic resistances and their dissemination among clinically relevant bacteria. The approach is based on the study of emerging integron diversity and antibiotic resistance genes associated to mobile genetic elements that facilitate their spread among nosocomial isolates of enterobacteria (*E. coli*, *K. pneumoniae*) and non-fermenting gram-negative bacilli such as *Pseudomonas aeruginosa* and *Acinetobacter*.

Pharmaceutical and food microbiology

Pharmaceutical microbiology, which has grown significantly over the last decade was present in the ALAM meeting. The purification of proteins without endotoxins as a critical step in the production of pharmaceutical proteins in *E. coli* (A. Pessoa Jr., Brazil); the establishment of an efficient two-phase purification system (with aqueous and organic phases); and the specific analytical methods required for the quality control of pharmaceutical drugs (S. Sutton, USA) were reported. The microbiological quality of Uruguayan pharmaceutical products was also discussed (A. Marenales, Uruguay). The validation of the process of ethylene oxide sterilization was explained by the therapeutic device manufacturer CEE Uruguay. Ethylene oxide sterilization is mainly used to sterilize pharmaceutical products that cannot support conventional high-temperature steam sterilization.

State-of-the-art food microbiology analysis was also updated. Some of the most frequent foodborne pathogens were discussed. *H. pylori* transmission via food and water was reviewed (A. García, Chile). *Enterococcus*, e.g., *E. faecalis*, *E. faecium*, *E. casseliflavus*, *E. raffinosus*, *E. durans* and *E. hirae*—classified in the past as *Streptococcus*—are lactic acid bacteria that cause important clinical infections. These bacteria are food pathogens (e.g., in sheep milk and cheese) and have pathogenicity islands (T. Crespo, Portugal). Pathogens were not the only microorganisms dealt with in that session, some probiotic *Enterococcus* strains were also described.

New molecular biology methods for food and clinical microbiology were discussed (J. Verdier, Uruguay; V. Rajal, Argentina). They included real-time PCR, which is useful for water analyses (V. Rajal, Argentina). A fast immunocolorimetric assay for the relevant food pathogens *Salmonella* spp., *Listeria monocytogenes* and *Listeria* spp. (M. Odizzio, Uruguay), and an immunoassay with magnetic beads for *E. coli* H7O157 (B. Briano, Uruguay) were also reported.



Agriculture and forestry microbiology

Plant pathogens have caused serious ecological problems and enormous economic losses around the world. *Ralstonia solanacearum* infects over 200 plant species including potato, tomato, banana, and ornamental plants. Functional genomics approaches allow for the discovery of host specificity and plant adaptation of this pathogen (C. Boucher, France). One approach is based on comparative genomics by hybridization of total genomic DNA from a wild-type strain collection on a pangenomic microarray. Another approach is based on the adaptation of a strain to a new host and the re-sequencing of its genome in order to identify genome changes. Different *Ralstonia solanacearum* isolates were characterized by multi-locus sequence typing (J.A. Castillo, Bolivia). Genetic analyses indicate that the chromosome and the plasmid of this plant pathogen have co-evolved.

Forestry is of increasing importance for the economy of Uruguay. In the last years *Eucalyptus* and pine plantations in Uruguay have increased significantly. However, in these plantation serious diseases have been detected. Pitch canker was observed on pines (R. Blanchette, USA), which is caused by *Fusarium circinatum* (R. Alonso, Uruguay). The pathogens of

juvenile *Eucalyptus* plants were studied, and the fungus *Teratosphaeria nubilosa* was identified as the main leaf disease pathogen of *Eucalyptus* spp. (S. Simon, Uruguay). To support tree plantation, mycorrhizal fungi that promote tree growth and protect roots from pathogens have been used (R. Blanchette, USA).

Environmental microbiology

Microbes have been on the Earth for 3800 million years and represent the main source of biodiversity. However, to date only a minor fraction of microorganisms are known. Microbial biodiversity is an outstanding treasure of Latin America, but it remains mainly undiscovered. A growing number of researchers in Latin America are entering this field. 2010 is the International Year of Biodiversity. Therefore, microbiologists have the challenge to point out the importance of microbial diversity for biodiversity. Microbes also play a major role in human health. The dynamics of microbial communities in diverse human ecosystems was studied using macro ecology approaches and cultivation-independent methods (R. Kolter, USA). The use of antibiotics changes the microbial communities in the nose and the throat. The role of actinobacteria in the control of human pathogens of the nose was highlighted. Stable isotope probing is an important method that allows scientists to link microbial diversity with function and is increasingly used in environmental microbiology (J.C. Murrell, UK).

Microbial populations form biofilms on surfaces. During biofilm formation nomad individual cells change into a sedentary multicellular stage. Microbial communication and biofilm formation by different bacteria such as *Bacillus subtilis* (R. Kolter, USA), *Rhizobium leguminosarum* (A. Zorreguieta, Argentina) and the uropathogen *Proteus mirabilis* (P. Zunino, Uruguay) were reviewed. The biofilm develops in different stages as a response to extracellular signals from the bacterial population. The adaptation of the pathogen fungus *Candida albicans* to environmental stress involves intracellular signaling including the mitogen-activated protein kinases pathway (J. Pla, Spain).

Extreme environments are a great source for biodiversity. The microbial communities of soils and diverse aquatic environments in Los Nevados national park in the Colombian Andes have been studied (M. Zambrano, Colombia). Metagenomic libraries of a soil and an aquatic ecosystem were established to search for novel microbial enzymes. PATRIC [www.patricbrc.org] provides powerful computa-

tional resources for research on all sequenced bacterial genomes (B. Sobral, USA). Genome analyses were used to understand the pathogenicity and epidemiology of *Salmonella enteritidis* pathogens in poultry (A. Chabalgoity, Uruguay). Structural and functional genomics of bacteria was applied to design and generate, by metabolic engineering, improved biocatalysts for biodegradation of polychlorinated biphenyls (M. Seeger, Chile).

A symposium sponsored by SEM, coordinated by E. García, covered topics that included the importance of microbial interactions (E. García, Spain) and symbiotic relations of bacteria and insects exemplified by gut microbiota termites and xylophagous cockroaches (*Cryptocercus punctulatus*), which can degrade lignocellulosic material; they are similar and include unique spirochetes and bacteroidetes (M. Berlanga, Spain).

The preservation of microbial resources and diversity is a major challenge for Latin America. However, only few of the countries in this region have public culture collections. Interestingly, many new culture collections have been established in Central Asia in the last years. A symposium devoted to the bacterial culture collections of the Latin American Federation of Culture Collections (FELACC) was coordinated by L. Loperena (Uruguay) and Z. Weng (Cuba). This active federation, established six years ago, already organized symposia in the ALAM meetings in Ecuador 2008 and Chile 2006.

Microbial biotechnology and bioenergy

The fossil fuel-based world economy of the 20th century is changing to an economy based on a biotechnology that uses renewable raw materials. At present, around 20% of the industrial chemicals are microbial products. Functional genomics is increasingly applied to optimize microbial production of compounds. The concept of biorefinery was highlighted (M. Gutiérrez, Peru). A symposium devoted to biotransformation was coordinated by S. Rodríguez (Uruguay). Novel biocatalysts were recovered from clone libraries of plant endophytes, environmental isolates and a metagenome (S. Rodríguez, Uruguay). Novel enzymes including endoglucanases, cellobiohydrolases (exocellulases) and endoxy-lanases for the conversion of lignocellulosic raw materials into bioethanol were isolated from tropical forest soil and thermal waters (G. K. Villena, Peru). Novel thermostable lipases were designed and generated by site directed mutagenesis (P. Díaz, Spain). Production of biosurfactants from low-

cost industrial residues was achieved using *Candida* yeasts (G.M. Campos-Takaki, Brazil). Biosurfactants have been successfully applied for bioremediation of petroleum hydrocarbons.

Bioremediation is an attractive technology for the cleanup of polluted environments. Cultivation-independent techniques including genetic profiles, catabolic microarrays and functional metagenomics are useful to understand the catabolic potential of native microbial communities for aromatic hydrocarbon-degradation (H. Junca, Colombia). Bioaugmentation using native bacteria was applied for the decontamination of pesticide-polluted soils (M. Seeger, Chile). Clone libraries showed the biodiversity of agricultural soils and fluorescence *in situ* hybridization (FISH) was used to study the dynamics of microbial communities in agricultural soil. Bacterial decontamination by denitrification, studied in Raigón aquifer at San José, Uruguay, and novel atrazine-degrading bacteria isolated from water supply plants in Montevideo and the south of the country were characterized (A. Fernández, Uruguay).

A symposium of bioenergy was coordinated by C. Etchebehere and C. Lareo (Uruguay). Brazil is one of the world's leading countries in bioethanol production. The challenges of second-generation bioethanol produced from lignocellulosic material was discussed (A.M. Souto-Maior, Brazil; D. Ferrari, Uruguay). To become an alternative energy source, the process has to be optimized and other commercial by-products have to be recovered. Bioenergy by methanogenesis and electrogenesis by microbes was reviewed (A. Stams, Netherlands). Methanogenesis is carried out by communities of physiologically different *Bacteria* and *Archaea*. Electrogenesis is a process in which anaerobic microorganisms degrade organic compounds for growth and use as an electron acceptor inert solid surfaces (e.g., *Geobacter*) or another microorganism (e.g., *Syntrophobacter*).

Microbiology education and public understanding of microbiology

For the training of microbiology professors and teachers, a pre-congress course focusing on the education of microbiology was held by J. Ortellado (Paraguay) and V. Rajal (Argentina). Novel methodologies and tools for teaching microbiology were presented and discussed. Graduate teachers from seven countries attended a one-day microbiology education course sponsored by UNESCO, ALAM and the American Society for Microbiology. S. Sutton (USA) held a

pharmaceutical microbiology course of microbiological methods and quality control for around fifty participants from seven Latin American countries. A post-congress course in bioinformatics, aimed at young scientists, was held by R. Colina (Uruguay). A lecture was devoted to the public understanding of microbiology: how the media deals with microbiology news, the need to see microbes not just as disease-causing organisms, and the role that schools and museums can play to improve the public perception of microbiology (M. Piqueras, Spain).

Latin American microbiology

The successful 20th ALAM meeting in Montevideo enforced coordination in microbiology within Latin America. ALAM 2008 had been held in Ecuador, chaired by María Fernanda Espinoza, president of the Ecuadorian Society for Microbiology. Held in the World Heritage City of Quito, ALAM 2008 attracted over 500 microbiologists from Latin America, North America, and Europe [3]. ALAM meetings are important for exchanging scientific information and for promoting scientific and technological cooperation in microbiology among Latin American countries and with other regions. ALAM meetings are also important for improving public health and environmental policies and regulations. Latin America has been growing and developing in the last decades. The percentages of gross domestic product (GDP) invested in research and development in Latin America increased from an average of 0.45% in 1998 to 0.68 in 2007 [2], with Brazil leading the investment in research and development. ALAM meetings have been essential for maintaining and strengthening microbiology, public health and agricultural, industrial and environmental development in Latin America.

The participation of a high number of young researchers and students who attended ALAM 2010, together with the leading experts in microbiology and related areas, will reinforce the growth and development of microbiology in Latin America. During the meeting, the Portuguese Society for Microbiology and the Colombian Society for Microbiology were welcomed as new full members of the ALAM assembly. Portugal and Spain are the only two societies outside the Americas that belong to ALAM. Microbiologists from Colombia and Costa Rica had been invited as guests to attend the ALAM Assembly at the previous 19th ALAM in Quito, Ecuador, to promote microbiology societies in their countries. In two years, Colombia successfully fulfilled the chal-

lenge and set up the Colombian Society for Microbiology, joining ALAM in Montevideo.

ALAM 2010 combined an intensive four-day scientific program with social events in the evening. Montevideo's *Ciudad Vieja* is well known for its traditional bars, restaurants and bookshops, where artists, poets and scientists frequently meet. The famous Uruguayan poet Mario Benedetti (1920- 2009), who inspired many young generations of Latin Americans with his love and political poems, wrote about life in these bars in his famous novel *Spring with a Broken Corner*. Microbiologists attending the ALAM congress enjoyed meeting at traditional bars such as Manchester and restaurants such as Ave Raris in *Ciudad Vieja*.

Finally, ALAM announced that the 21st ALAM meeting will take place in Santos, Brazil, from October 28 to Novem

ber 1st 2012, under the presidency of Adalberto Pessoa Jr. [pessoajr@usp.br]. The organizing committee is already working toward another successful Latin American microbiology meeting. Santos will welcome microbiologists from Latin America and the rest of the world.

References

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