Eliava Institute today: an overview

G. Eliava Institute of Bacteriophages, Microbiology and Virology,
Tbilisi, Georgia
Eliava Institute, Tbilisi, Georgia

• 1918 - 1923 - Central Bacteriological laboratory, Republic of Georgia, headed by George Eliava

• 1923 - 1935 - Inst. Bacteriology, Department of Healthcare of Georgia

• 1935 - 1937 - Inst. Microbiology and Epidemiology

• 1938 - 1950 - Inst. Microbiology, Epidemiology and Bacteriophages, Ministry of Health of the USSR

• 1950 - 1990 - Inst. Vaccines and Sera, Ministry of Health of the USSR

• 1990 - 1997 - Scientific-Industrial Union “Bacteriophage”, Ministry of Industry of Georgia

• 1997 - 2005 - G. Eliava Institute of Bacteriophage, Microbiology and Virology, Georgian Academy of Sciences

• 2005 - present - G. Eliava Institute of Bacteriophages, Microbiology and Virology with legal status of public law, Ministry of Science and Education
What we were producing in the past

- **Mono-phages** (*staphylococcal, streptococcal, E. coli, Pseudomonas, Dysenterial, typhoid*)
- **Poly-phages** (*Pyo, Intestì*)
- **Indicatory phages**
- **Sera to treat diphtheria, tetanus, gangrene, scarlet fever, meningococcus**
- **Sera for identification of Salmonella and Shigella**
- **Vaccines** (anti-rabies, anthrax, brucella, smallpox, intestinal)

_Ancient Phage preparations_
Structure of the Eliava Phage “Consortium”
Research at the Eliava Institute

Main Directions: Bacteriology, Microbiology, Molecular Biology

- Research of bacterial strains (including antibiotic-resistant strains) – causative agents of various infections in humans and animals

- Creation of phage-based remedies against bacterial infections (for humans, animals, plant protection, environmental decontamination)
Detailed study of phage properties

Phage biology and ecology
Morphology and single step growth properties
Phage selection based on virulence, host range, stability, physiology
Appearance and development of phage lysogeny,
Phage-host bacterial cell interaction
Serology and antigenic properties of phages
Physical and chemical properties of phage particles and DNA
Influence of environmental factors on phages
Phage-specific “killer” proteins
Eliava Institute organization

- Laboratory of Microbiology
- Laboratory of Applied Microbiology
- Laboratory of Molecular Biology
- Laboratory of Microbial Ecology
- Laboratory of Immunology
- Research and Development Group
- Phage and Bacterial Strain Collection
- Laboratory of Biological Control

61 in Institute staff: 45 – scientific personnel, 30 – on contract base, including 24 PhD and Master students
Scientific Grant Support and Collaboration

• During last 10 years, up to 40 International and National research grant support and fellowships

(ISTC, STCU, EU INTAS, NATO, FP7 framework, CRDF, DTRA, Dstl-UK, CEA-France, DoE, GNSF/Rustaveli Foundation, PhageBiotics Foundation, Private Donors)

• Collaboration with National: Georgian Scientific Centers (Lugar Center/NCDC, LMA), State or Private Universities
Regional: Armenia, Azerbaijan, Ukraine, Moldova
International: USA, Belgium, France, Switzerland, UK, Germany, Turkey, Canada, South Korea, Israel, Greece etc.
**Bacteriophages for Human Health**

- *(ISTC)* Construction of phage preparations against infection caused by *S. aureus* and *P. aeruginosa*

*Electron micrograph of Sb-1 phage (magn. x200 000, bar 100nm)*

*L. Kvachadze, N. Balarjishvili, T. Meskhi, E. Tevdoradze, N. Skhirtladze, T. Pataridze, R. Adamia, T. Topuria, E. Kutter, C. Rohde, M. Kutateladze*

Susceptibility of *S. aureus (MRSA)* strains to phages

*In vitro* screening: 467 MRSA from the UK collection -98.5%

54 MRSA and 38 toxin-producing (not MRSA) from German Strain and Culture collection (DSMZ) – 99%

56 MRSA from NYU – 95%

100 MRSA from Royal College of Surgeon (Ireland) – 97%

a) Electron micrograph of Staphylococcal phage Sb1; b) spot test results on bacterial lawn of *S. aureus (MRSA)*
Bacteriophages for Human Health

- **(CRDF)** Polyvalent bacteriophage preparation as an effective remedy against massive outbreaks of antimicrobial–resistant Salmonellosis

- **(ISTC)** Microflora of inflammatory process in chronic Prostatitis and Urogenital tracts in men and phage therapy prospects

- **(INTAS)** Development of phage-based therapy for Lung infections

- **(ISTC)** Creation and study of antimicrobial-antifungal composite using Biodegradable Polymer as a matrix

- **(ISTC)** Constructing of new phage composite for treatment of mixed infections

- **(STCU)** Anti-Cancer and Immunomodulatory Activity of Phage lysates
Bacteriophages for Animal Protection

- **(BTEP)** Validating the effectiveness of phage therapy concept using cow mastitis model
- **(STCU)** Ear infections (otitis) in domestic animals caused *P. aeruginosa*
- **(ISTC)** Development of phage cocktails for veterinary applications
- **(EU FP7 IRSES)** Network for the development of phage therapy in aquaculture
- **(STCU DoE US)** Anti-virus activity of indol-containing tetracyclic condensed systems (for application in veterinary medicine)
Bacteriophages for Plant Protection

• (CRDF) Elaboration of new phage-based strategy for control potato bacterial infections

• (STCU) Experimental evaluation of efficacy of bacteriophage treatment of bacterial blight in cotton and rice

• (CDR) Control of crown-gall disease in grape: integration of biological control with transgenesis
Food Safety and Environmental Monitoring

• *(GNSF)* Monitoring of salmonella distribution in poultry flacks, pig farms and in food (meat, eggs)

• *(GNSF)* The prevalence of foodborne pathogens in raw milk and milk products as a potential risk for public health in Georgia

• *(GRDF)* Elaboration of the standardized dairy starters for the traditional Caucasian dairy products

• *(GRDF-GNSF)* Development of the standard starter(s) for the Georgian cheese type “Imeruli”

• *(Tbilisi Water” Ltd)* Epidemiological analyses of bacterial and viral infections in Tbilisi city water
Phages for Environmental Monitoring

• *(STCU)* Study of the role of bacteriophages in the biology of sulfate-reducing bacteria

• *(STCU)* Investigation of polymeric biofilms formed by dangerous pathogens, their formation preventing by disinfectants and bacteriophages

• *(STCU CEA G8)* Application of bacteriophages against highly pathogenic bacteria in model studies

• *(GRDF/GNSF)* Bacteriophage as a Safe and Cost Effective Decontamination Alternative
Research at the Eliava Institute

- **(DTRA)** Isolation, distribution and biodiversity of selected *Vibrios* and their phages from the aquatic environment in Georgia
- **(DTRA)** Phage typing for identification of *Brucella spp.*
- **(DTRA)** Isolation and study of bacteriophages against *Y. pestis*, *B. anthracis* and *F. tularensis*
- **(DTRA)** Complete Genome sequencing of *Brucella* phages
- **(DTRA CRDF)** Characterization of mechanisms of adaptive phage-host co-evolution using next generation sequencing and phenotypic profiling
- **(EU FP7)** Anthrax environmental decontamination network
Research at the Eliava Institute

• (SCOPE) Phages for therapy of urinary tract infections: randomized placebo supported double blind clinical trials

• (SCOPE) Phages against infections caused by *Acinetobacter baumannii* (animal model studies)
Eliava Analytical-Diagnostic Center

-Bacteriological analyses (identification of pathogen, phage- and antibiotic-susceptibility tests) of clinical samples
-Phage susceptibility using commercial phages; laboratory phages

94 252 analyses per year (2012 – October, 2014)
49701 bacteriological tests among them
Eliava Biopreparations

**Pyo-Phage** (*Staphylococcus, E. coli, Streptococcus, Pseudomonas, Proteus*)

**Intesti phage** (*Shigella, Salmonella, entero-pathogenic E. coli, Proteus, Enterococci, Staphylococci and Pseudomonas aeruginosa*)

**Enkophage** (*Salmonella spp., Shigella spp., entero-pathogenic E. coli, Staphylococcus spp.*)

**SES phage** (*Staphylococcus spp., Streptococcus spp., E. coli*)

**Fersis** (*Staphylococcus spp., Streptococcus spp.*)

**Staphylococcal monophage**
Eliava Phage Therapy International Center

Urologist
Gynecologist
Pediatrician
Infectious disease specialist
Therapeutist
From 2012 to October 2014

- **5161 visits, 3238** for phage treatment
- Phage preparations were sent to 117 patients
- 37 Foreign Patients were treated, 11 – on distance (France, Canada, USA, Romania, Norway)
Why Phage Therapy?

• No effective treatment except antibiotics for today
• Serious problems of antibiotic-resistance
• Phage therapy – **ecologically safe approach** (do not affect normal microflora)
• No resistance with multi-component phage preparation
• There is no correlation between phage- and antibiotic-resistance
• 70 years of successful experience of using phages for therapy, prophylaxis and diagnostics in FSU
• **No serious side effects** have been reported from the Eliava Institute phages, despite use in hundreds of thousands of people since it was introduced
Why Phage Therapy?

- **Phages are available and easy to apply** (different forms: tablets, in liquid, suppositories etc.)
- **Compatible with the other therapy** (other antibacterial remedy, vaccine, probiotics)
- **Stable preparations** (no cold storage and long shelf life)
- **Cost effective** (in comparison to antibiotics)
Support for creating of Sustainability

• BII (US State Department): Support for creation of a Strategic Business Plan for the Eliava Institute

• Brochure describing activities of the Eliava Institute Website: www/eliava-institute.org

• Compilation of clinical results on phage application for human therapy and prophylaxis (Funded by the UK Ministry of Defence)

Support for Creating of Sustainability

**EU/UNICRI** Support for upgrading biosafety and biosecurity at the Eliava Institute

- Repairs and provision of equipment to essential laboratories of the G. Eliava Institute of Bacteriophages, Microbiology and Virology, Tbilisi, Georgia
- Update of Phage Production facility to the GMP level
- Upgrading lab conditions and procurement of laboratory equipment with enhanced technical parameters

- **DTRA CRDF** - Technology Commercialization Office
Phage therapy gets revitalized

The rise of antibiotic resistance rekindles interest in a century-old virus treatment.

Sara Reardon

03 June 2014 | Corrected: 04 June 2014

South American science by the numbers

Everything you've always wanted to know about research across the continent.
Recent publications on Phage Therapy
THANK YOU